

Comments on Power South Energy Cooperative Charles R. Lowman Power Station:

EPA:

Clarify which embankments have operational piezometers.

State:

None

Company:

See letter dated March 8, 2011

March 8, 2011

Stephen Hoffman
Office of Resource Conservation and Recovery (5304P)
U.S. Environmental Protection Agency
2733 Crystal Drive, 5th Floor
Arlington, VA 22202

Re: Assessment of Dam Safety of Coal Combustion Surface Impoundments:
PowerSouth Energy Cooperative, Charles R. Lowman Power Plant, August 6, 2010

Dear Mr. Hoffman:

This letter provides the comments of PowerSouth Energy Cooperative ("PowerSouth") on the above-noted draft report prepared by CDM. The draft report followed an on-site visit and inspection that took place at the Charles R. Lowman Power Plant ("Lowman") on July 1 and 2, 2010. Thank you for this opportunity to provide the views of PowerSouth.

PowerSouth has established a long history of safety and operational excellence at Lowman. We have operated ponds for the management of coal combustion byproducts ("CCBs") for decades, and we are confident that our CCB facilities and our operational practices are sound. We recognize the desire of the Environmental Protection Agency ("EPA") to assess the structural integrity of ash ponds around the country, including those at Lowman. In particular, we understand the concerns arising after the significant failure of a CCB disposal facility located at the Kingston Fossil Plant of the Tennessee Valley Authority in 2008. EPA has committed to identifying any other facilities posing a risk of failure comparable to the Kingston incident. CDM's draft report indicates that Lowman does not exhibit the physical or operational factors associated with the failure of the Kingston facility.

Nevertheless, we are not in complete agreement with some of the findings and conclusions of the draft report. Most critically, the draft report assigns a high hazard potential for the Units 2 and 3 Bottom Ash Pond ("#2/#3 Pond") and the Scrubber Waste Pond. A high hazard potential is appropriate only for a facility that poses a probable loss of human life in the event of a facility failure, regardless of the likelihood of such an event. There is no population center or residence close enough to Lowman to pose a risk of any kind. The only possible basis for the high hazard rating, as the draft report acknowledges, is the presence of a guard station located to the south of the #2/#3 Pond. However, as explained below, PowerSouth has undertaken additional analyses to demonstrate that the assumption of impacts to the guard station is unreasonable.

The draft report describes the potential impact of a berm failure – which, again, is without regard to whether failure is likely or unlikely to occur – as follows. Regarding the #2/#3 Pond, the report finds on page 4-1, "A breach could damage/washout the guard station located 85 feet south of the pond, resulting in guard station occupant(s) loss of life." Regarding the Scrubber Waste Pond, the draft report finds that a release

into the #2/#3 Pond could cause a breach of the #2/#3 Pond, which again could result in an impact to the guard station.

PowerSouth has determined that the guard station is located upgradient of the low point on the crest of the #2/#3 Pond. Specifically, topographic analysis using surveying methods indicates the topographic low point of the #2/#3 Pond exterior berm is located approximately 600 feet west of the guard station area and has an elevation of 42.09 feet. This is 1.04 feet below the elevation in the vicinity of the guard station. For that reason, it is not reasonable to assume that a dike failure would result in flows at or exceeding the elevation of the guard station or that the guard station would be impacted in any way. Therefore, the high hazard rating for the #2/#3 Pond and the Scrubber Waste Pond is unwarranted.

Further, even if the draft report's findings with respect to the guard station were warranted, that does not provide a basis to assign a high hazard rating to the Scrubber Pond. Again, a high hazard rating is appropriate if there is a probable loss of human life. It is not enough to state that a breach of the dike between the Scrubber Waste Pond and the #2/#3 Pond "could" result in a further breach of the #2/#3 Pond, which then could have an impact sufficient to justify the hazard rating. For CDM to assign a high hazard rating to the Scrubber Waste Pond, CDM must find that a loss of human life is probable. The draft report does not demonstrate that it is probable that a Scrubber Waste Pond breach would cause a breach of the south dike of the #2/#3 Pond. Therefore, a high hazard rating for the Scrubber Waste Pond is unsupported.

Because the draft report overestimates the hazard potential for the CCB facilities at Lowman, it then applies unduly conservative assumptions in the assessment of hydraulic, hydrologic, and structural stability issues. Given a significant rather than high hazard potential, the appropriate analysis is to consider a 50% probable maximum precipitation ("PMP") scenario. PowerSouth has determined that the CCB facilities are hydraulically capable of safely passing the 50% PMP event. Even under the far more unlikely 100% PMP flood event, the amount of potential overtopping is limited to the #2/#3 Pond and is slight (0.05 feet). This amount can be managed using existing pumps and readily available pumping methods to distribute water to other ponds.

Regulations of the Alabama Department of Environmental Management ("ADEM") require that solid waste disposal facilities located in a Seismic Impact Zone be designed to conform to more stringent requirements by resisting horizontal acceleration in lithified earth material generated from earthquakes (required pseudostatic factor of safety of 1.2). See generally ADEM Admin. Code r. 335-13-4-.01. The regulations define "Seismic Impact Zone" as "an area with a ten percent or greater probability that the maximum horizontal acceleration in lithified earth material, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 250 years." ADEM Admin. Code r. 335-13-1-.03(140). Based on review of available seismic maps ("Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years"; USGS Map; 2008), the maximum horizontal acceleration at Lowman is approximately 0.07g. Therefore, the site is not located within a Seismic Impact Zone. Additionally, the "United States Seismic Zone Map" (1997 Uniform Building Code) indicates that Lowman Powerplant is located in Seismic Zone 0 with a corresponding 0.0g ground acceleration. Thus, even if CCB impoundments in Alabama were regulated by ADEM, seismic analyses would be unnecessary.

The draft report assigned a "poor" condition rating to the #2/#3 Bottom Ash, Scrubber Waste and Process Waste Ponds, based primarily on a lack of information. In response to these findings, CDG Engineers & Associates, Inc. (CDG) performed additional analyses summarized in this letter and contained

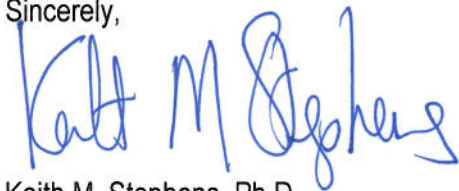
in the enclosed report. Based on this new information, PowerSouth believes that the "poor" condition ratings of these impoundments should be upgraded to "fair" to more accurately characterize their condition.

In addition to the foregoing, PowerSouth offers the following comments on relatively minor issues:

- Page 1-3, 2nd paragraph, and page 2-6, Section 2.4.2: The spur located on the crest of the embankments of several of the CCB ponds is owned and maintained by PowerSouth rather than Norfolk Southern Railway.
- Page 2-3, Section 2.3.1: PowerSouth concurs that vegetation exists on the west embankment exterior slope, but the description of trees of up to 8 inches in diameter is exaggerated. In any event, PowerSouth intends to remove the large vegetation in this area.
- Page 2-4, Section 2.3.1, 3rd paragraph; page 2-5, Section 2.4.1, 4th paragraph; and page 4-6: We have evaluated the areas described herein and cannot confirm the source of any water as coming from groundwater or the pond. PowerSouth intends to continue to monitor this area in accordance with our inspection and maintenance practices. To the extent the draft report may suggest or imply that any visible water originates from any pond, such an inference is unsupported.
- Page 2-5, Section 2.4.1: PowerSouth concurs that vegetation exists on the exterior slope of the west embankment of the Scrubber Waste Pond, but the description of trees of up to 18 inches in diameter is exaggerated. In any event, PowerSouth intends to remove the large vegetation in this area.

In support of PowerSouth's findings and positions, please find enclosed a report prepared by CDG. Please feel free to contact me at (334) 427-3373 or keith.stephens@powersouth.com should you have any questions about the comments of PowerSouth or the enclosed report. In the meantime, thank you again for this opportunity to share our views.

Sincerely,



Keith M. Stephens, Ph.D.
Manager, Environmental Services

Enclosure

cc: Bill Friers, CDM

REPORT OF TOPOGRAPHIC AND HYDRAULIC ANALYSIS

**Coal Combustion Waste Impoundments
Charles R. Lowman Power Plant
Leroy, Alabama
CDG Project Number: 061021203
March 2, 2011**

Prepared for:

**Mr. Scott Chastain
PowerSouth Energy Cooperative
Charles R. Lowman Power Plant
Post Office Box 10
Leroy, Alabama 36458**

Prepared by:

**CDG Engineers & Associates, Inc.
1830 Hartford Highway
Dothan, Alabama 36301
Phone: (334) 677-9431
Fax: (334) 677-9450**





March 3, 2011

PowerSouth Energy Cooperative
Charles R. Lowman Power Plant
Post Office Box 10
Leroy, Alabama 36458

CIVIL
ENGINEERING

Attention: Mr. Scott Chastain

ENVIRONMENTAL
ENGINEERING

Reference: **Report of Topographic and Hydraulic Analysis
Coal Combustion Waste Impoundments
Charles R. Lowman Power Plant
Leroy, Alabama
CDG Reference Number: 061021203**

GEOTECHNICAL
SERVICES

Dear Mr. Chastain:

GEOLOGIC
SERVICES

CDG Engineers & Associates, Inc. (CDG) has completed the authorized supplemental impoundment evaluation and hydrologic/hydraulic modeling for the existing coal combustion waste (CCW) impoundments at the Charles R. Lowman Power Plant in Leroy, Alabama. Our services were performed in general accordance with an email from Mr. Larry Spann dated January 10, 2011.

LAND
SURVEYING

CDG previously performed a stability analysis of representative berm slopes associated with the CCW impoundments. The evaluation identified a berm on the Process and Scrubber Waste Ponds that exhibited an insufficient factor of safety. Additionally, maintenance and inspection recommendations were provided. PowerSouth has initiated efforts to comply with the recommendations of the initial evaluation.

PO Box 278 (36420)
1840 East Three Notch Street
Andalusia, Alabama
36421

During design of compliance measures, CDG received the draft report entitled "Assessment of Dam Safety of Coal Combustion Surface Impoundments" (dated August 6, 2010) prepared by CDM (herein referred to as the *Draft CDM Report*). The *Draft CDM Report* identified unfavorable ratings associated with the existing impoundments and berms, and stated that additional engineering analyses are required to further evaluate impoundment condition. The purpose of this study is to address the unfavorable ratings in part by presenting the results of additional evaluations performed within the limited timeframe available prior to the finalization of the *Draft CDM Report*.

TEL: 334.222.9431
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We appreciate the opportunity to work with you on this project. Please call if you have any questions or need additional information.

*Providing solutions...
building relationships*

Respectfully Submitted,
CDG Engineers & Associates, Inc.

R. Daniel Wells, PE
Project Manager

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EXECUTIVE SUMMARY

The draft report entitled “Assessment of Dam Safety of Coal Combustion Surface Impoundments” (dated August 6, 2010) prepared by CDM identified unfavorable ratings associated with the existing impoundments at the Charles R. Lowman Power Plant. CDM recommended additional engineering analyses be performed to further evaluate berm stability.

The purpose of this study is to address the unfavorable ratings and the request for additional information contained in CDM’s report. CDG’s scope of services consisted of an evaluation of the failure risk in the guard station area, and a hydrologic/hydraulic analysis to establish maximum surcharge (flood) elevations within the impoundments. The scope of services was limited by the timeframe allowed to respond to CDM’s report.

The “high” hazard rating associated with #2/#3 Bottom Ash and Scrubber Waste Impoundments is attributable to the presence of the Guard Station located 85 feet south of the Unit #2/3 Bottom Ash Pond. The basis for this hazard classification is identified as *“A breach could damage/washout the guard station located 85 feet south of the pond, resulting in guard station occupant(s) loss of life.”* An evaluation of the topography in this area indicates that the guard station area is up-gradient from the exterior berm of the Unit #2/3 Ash Pond. Therefore, it is CDG’s opinion that berm failure due to overtopping in the guard station area is not a reasonable scenario and the ponds should be classified as “significant” hazard rather than “high” hazard.

The “poor” condition rating assigned to the Process Waste, Scrubber Waste and the #2/#3 Bottom Ash Pond berms is due in part to the absence of hydrologic/hydraulic analyses under probable maximum precipitation (PMP) events conditions (flood). Therefore, further analyses of various water balance scenarios have been completed to evaluate the structure’s ability to safely pass the appropriate PMP event. Analyses identified maximum surcharge (flood) elevations within the impoundments under various water balance scenarios and clarified the impoundments hydraulic functionality during PMP events.

However, coal ash impoundments (and earthen dams) are currently unregulated in Alabama. Therefore, there are not established criteria to which the impoundments at Lowman must adhere. CDM’s report recommends compliance based on US Army Corps of Engineers and FEMA requirements which are generally developed for large watershed reservoirs. These stringent regulations require compliance to highly improbable precipitation events that may not be appropriate for the Lowman operations.

Additionally, it should be noted that other regulating agencies (e.g. Federal Energy Regulatory Commission, US Bureau of Reclamation) provide differing methodology for hydrologic/hydraulic modeling that may differ from those recommended in the *Draft CDM Report*. Therefore, Corps and FEMA regulations may not be appropriate for the Lowman site.

1.0 SCOPE OF SERVICES

CDG's current scope of services consisted of a topographic analysis to determine impoundment geometries and a hydrologic/hydraulic analysis to establish flood elevations resulting from the probable maximum precipitation event. This report presents an evaluation of the failure risk in the guard station area based on topographic analysis along with the results of the hydrologic/hydraulic analysis.

These analyses were primarily performed to address the deficiencies leading to the unfavorable ratings contained in the *Draft CDM Report* which consist of the "high" hazard rating assigned to the Scrubber Waste and #2/#3 Bottom Ash Impoundments and the "poor" condition rating assigned to the Process Waste, Scrubber Waste and the #2/#3 Bottom Ash Impoundments. Per the *Draft CDM Report* the "poor" condition of the impoundments were in part due to the lack of hydrologic/hydraulic modeling at the facility.

The scope of services was limited by the timeframe allowed to respond to the *Draft CDM Report*. Therefore, a complete scope of services including additional soil test borings, piezometer installation, laboratory testing and additional stability analyses were unable to be completed prior to this response. Additional studies and engineering analysis should be performed if required once the *Draft CDM Report* is finalized.

2.0 TOPOGRAPHIC SURVEY FINDINGS – GUARD STATION AREA

The *Draft CDM Report* assigns "high" hazard ratings to the #2/#3 Ash and Scrubber Waste ponds primarily due to the potential for loss of life during breach in the guard station area. In CDG's opinion, failure due to overtopping/washout in the guard station area is not a plausible scenario due to the location of the topographic highs/lows in the exterior berm of the #2/#3 Unit Ash Pond.

Topographic analysis of the #2/#3 Bottom Ash Impoundment was performed through surveying methods to evaluate the likelihood of breach due to overtopping in the guard station area. The results of this analysis indicate the topographic low point of the exterior berm of #2/#3 Ash Pond is located approximately 600 feet west of the guard station area. As such, the most likely location of breach due to overtopping would occur at this location at an elevation of 42.09, 1.04 vertical feet below the berm crest elevation in the vicinity of the guard station. Therefore, it is CDG's opinion that berm failure due to overtopping in the guard station area is highly unlikely and the ponds should be classified as "significant" hazard rather than "high" hazard, as initially recommended in the *Draft CDM Report*.

3.0 HYDROLOGIC/HYDRAULIC ANALYSIS

As required in the *Draft CDM Report*, a complete hydrologic/hydraulic analysis has been performed for the Lowman plant using methodology prescribed in FEMA Dam Safety Guidance. CDG has completed the model as recommended, which references development of probable maximum precipitation (PMP) and probable maximum flood (PMF) criteria as a basis for storm simulation.

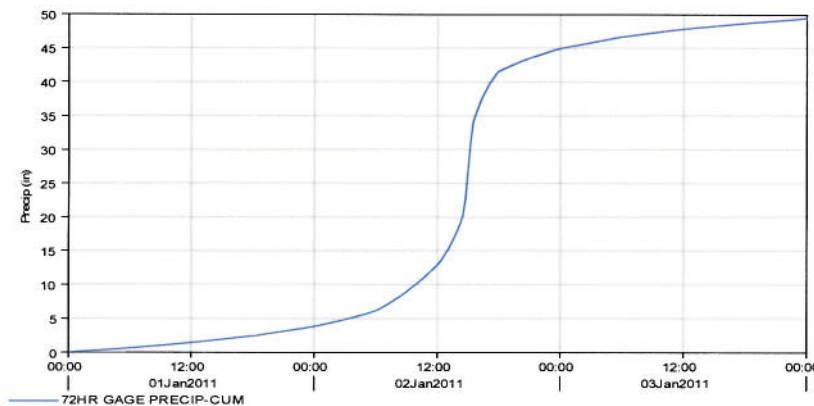
3.1 HYDROLOGIC MODEL DEVELOPMENT

Hydrologic parameters for storm simulation have been developed using the probable maximum precipitation (PMP) estimates from data available in *NOAA Hydrometeorological Report No. 51 (HMR 51) Probable Maximum Precipitation Estimates – United States East of the 105th Meridian*, summarized in Table 1 below.

TABLE 1 – Summary of PMP Estimates from HMR-51					
Storm Area	Total Precipitation (in)				
Sq. Mi.	6 hr.	12 hr.	24 hr.	48 hr.	72 hr.
10	31.5	38.1	46	50	54
200	24	30	38	42	46
1000	18	24	32	36	39
5000	10	14.8	21	25	29.8
10000	7.55	11.7	17	22	26
20000	5.5	9.1	13.4	17.6	21.5

Following determination of PMP estimates for varying storm sizes and durations, the Probable Maximum Storm (PMS) was developed using methodology described in *NOAA Hydrometeorological Report No. 52 (HMR 52) Application of Probable Maximum Precipitation Estimates – United States East of the 105th Meridian* and its corresponding HMR 52 software program. The resulting PMS model is indicated below in cumulative-rainfall form with complete analytical results contained in APPENDIX A.

Figure 1-Cumulative Precipitation Curve (72-hr)



Probable Maximum Storm simulations for hydraulic modeling are determined to be:

- 49.40" over a 72-hr period (100% PMP)
- 13.81" over a 24-hr period

3.2 HYDRAULIC MODEL DEVELOPMENT

Following the development of the PMP/PMS hydrologic model, CDG utilized the USACE HEC-HMS program to develop hydraulic modeling scenarios for Plant operations occurring during Probable Maximum Storm (PMS) events. Plant operations were modeled under four (4) water balance scenarios provided by Plant personnel, which are described in more detail in APPENDIX B.

Outflow from the CCW impoundments is controlled through a series of pumping structures that circulate water from the respective impoundments to their outfalls depending on the operational scenarios being employed at the time of the PMS event. Pump rates and outflow capacities were provided by Plant personnel, and verified through pump model information and available water balance data.

Results of the maximum surcharge pool elevation under each scenario are provided in Table 2 below. Complete analyses of all CCW impoundments are included in APPENDIX B.

TABLE 2 - Maximum Surcharge Pool Elevation [FT] (24hr Storm Duration)								
	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	50% PMP	100% PMP	50% PMP	100% PMP	50% PMP	100% PMP	50% PMP	100% PMP
Unit 1 Ash Pond	31.90	32.48	31.90	32.48	31.59	32.19	31.59	32.19
Units 2/3 Ash Pond	39.59	40.16	39.59	40.16	39.75	40.31	39.75	40.31
Scrubber Waste Pond	38.49	39.04	38.49	39.04	38.49	39.04	38.49	39.04
Process Waste Pond	35.62	36.27	35.48	36.01	35.48	37.98	35.62	36.27
(72hr Storm Duration)								
	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	50% PMP	100% PMP	50% PMP	100% PMP	50% PMP	100% PMP	50% PMP	100% PMP
Unit 1 Ash Pond	33.91	35.98	33.91	35.98	33.19	35.21	33.11	35.21
Units 2/3 Ash Pond	41.08	42.04	41.08	42.04	41.48	42.14	41.48	42.06
Scrubber Waste Pond	39.73	41.67	39.73	41.67	39.73	41.67	39.73	41.67
Process Waste Pond	37.28	39.47	36.58	38.44	38.50	40.32	37.29	39.47

4.0 SUMMARY OF FINDINGS

The purpose of the current evaluation was to address the unfavorable ratings contained in the *Draft CDM Report*. Those ratings consist of the “high” hazard rating assigned to the #2/#3 Bottom Ash and Scrubber Waste Impoundments and the “poor” condition rating assigned to the Process Waste, Scrubber Waste and the #2/#3 Bottom Ash Impoundments.

The “high” hazard rating associated with Scrubber Waste and #2/#3 Bottom Ash Impoundments results from the presence of the Guard Station on the southern side of the #2/#3 Bottom Ash Pond. Based on topographic evaluation of the exterior berm of the Unit #2/3 Bottom Ash Pond, the guard station is up-gradient from the remainder of the berm. **Therefore, it is CDG’s opinion that berm failure or overtopping due to flooding in the guard station area is not a reasonable scenario and the ponds should be classified as “significant” hazard rather than “high” hazard.**

The “poor” condition rating assigned to the Process Waste, Scrubber Waste and the #2/#3 Bottom Ash Pond berms is due in part to the absence of previous hydrologic/hydraulic modeling for facility operations during a PMP event.

Therefore, complete analysis of various water balance scenarios were performed under the methodology recommended in the *Draft CDM Report*. Analyses indicate that the impoundments are hydraulically capable of safely passing the 50% PMP event assigned to “significant” hazard ratings. In addition, an analysis of the impoundments under 100% PMP flood event was performed to determine adequacy, with only Unit #2/3 slightly overtopping (0.05’) at the topographic low point of the exterior berm.

As recommended in CDG’s original report, remediation including construction of a toe berm along the northwest berm of the Process Waste and Scrubber Waste Ponds will increase the factors of safety to an acceptable level under normal pool and maximum surcharge (flood) conditions.

However, it is CDG’s opinion that all loading conditions considered in the *Draft CDM Report* may not be appropriate for the Lowman impoundments. In addition, events resulting in seismic, liquefaction, or rapid drawdown conditions are highly improbable, as the Lowman facility is located in an area of very low seismicity. Therefore, analyses based on the rapid drawdown, seismic and liquefaction loading conditions may not be appropriate.

5.0 GENERAL REMARKS AND CLOSING

This report has been prepared for the exclusive use of PowerSouth Energy Cooperative for specific application to the Coal Ash Containment Pond Berm Analysis project at Charles R. Lowman Power Plant in Leroy, Alabama and is not transferable to a third party. The recommendations in this report are intended for use on the stated project and should not be used for other purposes.

The conclusions, analyses, and recommendations presented in this report are based upon currently accepted engineering principles, practices, and existing testing standards in the area where the services were provided. No other warranty, expressed or implied, is made.

The scope of services associated with this report was limited by the time constraints of the project. As detailed previously, additional engineering evaluation to further evaluate impoundment stability may be conducted as appropriate regulations are developed for CCW storage impoundments.

APPENDIX

A

HEC-HMR 52 Program Results

LOWOUT.OUT

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1 *****  

* *****  

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* PROBABE MAXIMUM STORM (HMR52)  

ENGINEERS *  

* NOVEMBER 1982  

ENGINEERING CENTER *  

* REVISED APRIL 91  

STREET *  

* 95616 *  

** RUN DATE 01/31/2011 TIME 10:54:01 **  

460-1748 *  

* *  

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HEC	PROBABLE	MAXIMUM	STORM	(HMR52)	INPUT	DATA
H	H	M	M	RRRRRR	555555	222222
H	H	MM	MM	R	5	2
H	H	M	M	R	5	2
HHHHHH	M	M	M	RRRRRR	555555	2
H	H	M	M	R	5	2
H	H	M	M	R	5	2
H	H	M	M	R	5	2
H	H	M	M	R	55555	222222

PAGE 1

ID.....	1.....	2.....	3.....	4.....	5.....	6.....	7.....	8.....	9.....	10.....
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ID	PROBABLE MAXIMUM STORM CALCULATION IN HMR NO. 52
ID	LOWMAN POWER PLANT
ID	PMS CALCULATION FOR THE TOTAL BASIN

FREE

[illegible]

Page 1

LOWOUT.OUT

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16      HO      250
    **
    ** FIND STORM AREA AND ORIENTATION FOR PMS CENTERED AT BASIN CENTROID
17      SA      0
18      GO
    **
    ** CALCULATE STORM CENTERED
    ** USING GIVEN STORM AREA AND ORIENTATION
19      SC 1815130 536980
20      SA      10 250
21      ST      5 .270
22      ZZ
1*****
*****
*
* PROBABLE MAXIMUM STORM (HMR52)
ENGINEERS *
* NOVEMBER 1982
ENGINEERING CENTER *
REVISED APRIL 91
STREET *
95616 *
* RUN DATE 01/31/2011 TIME 10:54:01 *
460-1748 *
*****
*****
*
* U.S. ARMY CORPS OF
THE HYDROLOGIC
609 SECOND
DAVIS, CALIFORNIA
(916) 551-1748 OR (FTS)
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PROBABLE MAXIMUM STORM CALCULATION IN HMR NO. 52 LOWMAN POWER PLANT PMS CALCULATION FOR THE TOTAL BASIN

PMP DEPTHS FROM HMR 51

AREA (SQ. MI.)	6-HR	12-HR	24-HR	48-HR	72-HR
10.	31.50	38.10	46.00	50.00	54.00
200.	24.00	30.00	38.00	42.00	46.00
1000.	18.00	24.00	32.00	36.00	39.00
5000.	10.00	14.80	21.00	25.00	29.80
10000.	7.55	11.70	17.00	22.00	26.00
20000.	5.50	9.10	13.40	17.60	21.50

LOWOUT.OUT

STORM AREA	31.29	7.41	3.71	2.49	PMP	DEPTHS FOR 6-HOUR INCREMENTS	95	.85	.76	.69
10.	29.53	7.30	3.69	2.49	1.88	1.51	1.26	1.08	.85	.70
25.	28.05	7.23	3.68	2.49	1.88	1.51	1.27	1.09	.85	.70
50.	25.90	7.09	3.66	2.49	1.88	1.52	1.27	1.09	.85	.70
100.	24.16	6.99	3.64	2.48	1.88	1.52	1.27	1.10	.86	.70
175.	22.24	7.00	3.61	2.45	1.86	1.50	1.25	1.08	.95	.69
300.	20.71	7.05	3.59	2.42	1.83	1.47	1.23	1.06	.93	.68
450.	19.06	7.10	3.56	2.39	1.80	1.45	1.21	1.04	.91	.67
700.	17.73	7.13	3.53	2.37	1.78	1.43	1.19	1.03	.90	.66
1000.	15.74	6.64	3.45	2.34	1.78	1.43	1.20	1.03	.91	.66
1500.	13.99	6.18	3.36	2.33	1.78	1.44	1.21	1.04	.92	.74
2150.	12.38	5.71	3.28	2.31	1.78	1.45	1.23	1.06	.94	.76
3000.	10.43	5.16	3.16	2.28	1.79	1.47	1.25	1.09	.96	.84
4500.	9.02	4.70	3.03	2.24	1.78	1.47	1.26	1.10	.98	.71
6500.	7.51	4.20	2.86	2.18	1.76	1.47	1.27	1.11	.99	.73
10000.	6.36	3.72	2.60	1.99	1.62	1.36	1.18	1.04	.93	.75
15000.	5.55	3.39	2.40	1.86	1.52	1.29	1.11	1.04	.84	.70
20000.								.98	.80	.67

1

BOUNDARY COORDINATES FOR LOWMAN

X 1807550.0	1807490.0	1814090.0	1817830.0	1820150.0	1821620.0	1822600.0	1821740.0	1825530.0	1823820.0
Y 524000.0	543220.0	548970.0	546400.0	548970.0	549150.0	547250.0	545170.0	539970.0	536420.0
X 1822840.0	1821440.0	1817830.0	1815870.0						
Y 537340.0	532260.0	532200.0	526390.0						

SCALE = .0002 MILES PER COORDINATE UNIT

BASIN AREA = 10.8 SQ. MI.

BASIN CENTROID COORDINATES, X = 1814913.0, Y = 537444.1

1

VARYING STORM AREA SIZE AND FIXED ORIENTATION

SUM OF DEPTHS
ORIENT-
FOR 3 PEAK
STORM AREA
6-HR PERIODS

BASIN-AVERAGED INCREMENTAL DEPTHS FOR 6-HR PERIODS

10.	205.	30.23	7.16	3.59	2.41	1.82	1.46	1.22	1.05	.92	.82	.74	.67
40.98													
25.	205.	29.92	7.48	3.72	2.49	1.88	1.51	1.27	1.09	.95	.85	.77	.70
41.13													
50.	205.	29.55	7.60	3.73	2.49	1.88	1.51	1.27	1.09	.95	.85	.77	.70

Page 3

40.88	205.	28.84	7.62	3.74	2.49	1.88	1.52	1.27	1.09	.96	.85	.77	.70
100.	205.	28.57	7.66	3.74	2.48	1.88	1.52	1.27	1.10	.96	.86	.77	.70
175.	205.	27.85	7.77	3.73	2.45	1.86	1.50	1.25	1.08	.95	.84	.76	.69
39.97	205.	27.14	7.93	3.71	2.42	1.83	1.47	1.23	1.06	.93	.83	.74	.68
300.	205.	26.42	8.07	3.68	2.38	1.80	1.44	1.21	1.04	.91	.81	.73	.66
450.	205.	26.05	8.18	3.66	2.35	1.77	1.42	1.18	1.02	.89	.79	.71	.65
38.78	205.	24.99	7.64	3.56	2.31	1.75	1.41	1.18	1.02	.89	.80	.72	.65
700.	205.	23.94	7.14	3.46	2.28	1.74	1.41	1.19	1.02	.90	.80	.72	.66
38.16	205.	22.78	6.60	3.35	2.24	1.73	1.41	1.19	1.03	.91	.81	.73	.67
1000.	205.	21.29	6.03	3.24	2.21	1.73	1.42	1.21	1.05	.93	.83	.75	.69
37.89	205.	20.23	5.54	3.12	2.17	1.72	1.43	1.22	1.07	.95	.85	.77	.71
1500.	205.	18.93	5.03	2.96	2.11	1.70	1.43	1.23	1.08	.96	.87	.79	.72
36.20	205.	17.76	4.50	2.69	1.93	1.57	1.32	1.14	1.00	.90	.81	.74	.68
34.55	205.	16.66	4.13	2.50	1.81	1.47	1.25	1.08	.95	.85	.77	.70	.65
32.72	205.												
4500.	205.												
30.56	205.												
6500.	205.												
28.88	205.												
10000.	205.												
26.92	205.												
15000.	205.												
24.96	205.												
20000.	205.												
23.29	205.												

FIXED STORM AREA SIZE AND VARYING ORIENTATION

SUM OF DEPTHS
FOR 3 PEAK
STORM AREA
6-HR PERIODS

BASIN-AVERAGED INCREMENTAL DEPTHS FOR 6-HR PERIODS

25.	140.	29.03	7.30	3.65	2.45	1.85	1.49	1.25	1.07	.94	.84	.75	.69
39.98	150.	29.20	7.33	3.67	2.46	1.86	1.49	1.25	1.07	.94	.84	.76	.69
25.	160.	29.42	7.38	3.68	2.47	1.87	1.50	1.26	1.08	.95	.84	.76	.69
40.48	170.	29.64	7.43	3.70	2.48	1.88	1.51	1.26	1.08	.95	.85	.76	.69
40.77	180.	29.76	7.45	3.71	2.49	1.88	1.51	1.26	1.09	.95	.85	.76	.70
40.93	190.	29.84	7.47	3.72	2.49	1.88	1.51	1.27	1.09	.95	.85	.77	.70
41.03	200.	29.92	7.48	3.72	2.49	1.88	1.51	1.27	1.09	.95	.85	.77	.70
25.													

		LOWOUT.OUT											
ISOHYET AREA (SQ.MI.)	AREA WITHIN BASIN (SQ.MI.)	1	2	3	4	5	6	7	8	9	10	11	12
41.13	9.	29.91	7.48	3.72	2.49	1.88	1.51	1.27	1.09	.95	.85	.77	.70
25.	11.	29.87	7.47	3.72	2.49	1.88	1.51	1.27	1.09	.95	.85	.77	.70
41.11	11.	29.81	7.46	3.72	2.49	1.88	1.51	1.27	1.09	.95	.85	.77	.70
25.	11.	29.65	7.43	3.71	2.48	1.88	1.51	1.26	1.08	.95	.85	.76	.69
41.06	11.	29.40	7.38	3.68	2.47	1.87	1.50	1.26	1.08	.95	.84	.76	.69
25.	11.	29.18	7.33	3.66	2.46	1.86	1.49	1.25	1.07	.94	.84	.76	.69
40.99	11.	29.00	7.29	3.65	2.45	1.85	1.49	1.24	1.07	.94	.83	.75	.68
25.	11.	28.87	7.26	3.64	2.44	1.84	1.48	1.24	1.07	.93	.83	.75	.68
40.78	11.	28.82	7.25	3.63	2.44	1.84	1.48	1.24	1.06	.93	.83	.75	.68
25.	11.	28.85	7.26	3.64	2.44	1.84	1.48	1.24	1.07	.93	.83	.75	.68
40.46	11.	28.93	7.28	3.64	2.45	1.85	1.49	1.24	1.07	.94	.83	.75	.68
25.	11.	29.89	7.48	3.72	2.49	1.88	1.51	1.27	1.09	.95	.85	.77	.70
40.17	11.	29.92	7.48	3.72	2.49	1.88	1.51	1.27	1.09	.95	.85	.77	.70

1

STORM AREA = 25. SQ. MI., PROBABLE MAXIMUM STORM FOR LOWMAN
 STORM CENTER COORDINATES, X = 1814913.0, Y = 537444.1, ORIENTATION = 200., PREFERRED ORIENTATION = 250.

		DEPTHS (INCHES) FOR 6-HOUR INCREMENTS OF PMS											
ISOHYET AREA (SQ.MI.)	AREA WITHIN BASIN (SQ.MI.)	1	2	3	4	5	6	7	8	9	10	11	12
A 10.	9.	30.12	7.52	3.73	2.49	1.88	1.51	1.27	1.09	.95	.85	.77	.70
B 25.	11.	28.05	7.15	3.66	2.49	1.88	1.51	1.27	1.09	.95	.85	.77	.70
C 50.	11.	19.78	5.25	2.75	1.86	1.40	1.13	.94	.81	.71	.63	.57	.52
D 100.	11.	15.35	4.31	2.23	1.51	1.14	.92	.77	.66	.58	.51	.46	.42
E 175.	11.	12.70	3.50	1.79	1.21	.91	.73	.61	.53	.46	.41	.37	.34
F 300.	11.	10.04	2.85	1.48	1.00	.75	.61	.51	.44	.38	.34	.31	.28
G 450.	11.	8.27	2.37	1.26	.85	.64	.51	.43	.37	.32	.29	.26	.24
H 700.	11.	6.50	1.90	1.00	.67	.51	.41	.34	.29	.26	.23	.21	.19
I 1000.	11.	5.02	1.46	.79	.54	.40	.33	.27	.23	.21	.18	.16	.15
J 1500.	11.	3.54	1.13	.63	.42	.32	.26	.22	.18	.16	.14	.13	.12
K 2150.	11.	2.07	.77	.42	.29	.22	.17	.15	.13	.11	.10	.09	.08
L 3000.	11.	.89	.36	.18	.12	.09	.08	.06	.05	.05	.04	.04	.03
M 4500.	11.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
N 6500.	11.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

STORM AREA = 10. SQ. MI., ORIENTATION = 250., PREFERRED ORIENTATION = 250.
 STORM CENTER COORDINATES, X = 1815130.0, Y = 536980.0

AREA WITHIN BASIN (SQ.MI.)		DEPTHS (INCHES) FOR 6-HOUR INCREMENTS OF PMS											
ISOHYET AREA (SQ.MI.)		1	2	3	4	5	6	7	8	9	10	11	12
A 10.	31.29	7.41	3.71	2.49	1.88	1.51	1.26	1.08	.95	.85	.76	.69	
B 25.	20.02	4.74	2.41	1.62	1.22	.98	.82	.71	.62	.55	.50	.45	
C 50.	15.02	3.56	1.78	1.20	.90	.73	.61	.52	.46	.41	.37	.33	
D 100.	11.89	2.89	1.45	.97	.73	.59	.49	.42	.37	.33	.30	.27	
E 175.	9.39	2.22	1.11	.75	.56	.45	.38	.33	.29	.25	.23	.21	
F 300.	7.51	1.78	.89	.60	.45	.36	.30	.26	.23	.20	.18	.17	
G 450.	5.94	1.48	.74	.50	.38	.30	.25	.22	.19	.17	.15	.14	
H 700.	4.38	1.04	.52	.35	.26	.21	.18	.15	.13	.12	.11	.10	
I 1000.	3.13	.74	.37	.25	.19	.15	.13	.11	.10	.08	.08	.07	
J 1500.	1.88	.52	.24	.16	.12	.10	.08	.07	.06	.06	.05	.05	
K 2150.	.63	.22	.11	.07	.06	.05	.04	.03	.03	.03	.02	.02	
L 3000.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
M 4500.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
N 6500.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
O 10000.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
P 15000.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
Q 25000.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
R 40000.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
S 60000.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
AVERAGE DEPTH	28.66	6.79	3.40	2.29	1.73	1.39	1.16	1.00	.87	.78	.70	.64	

TIME INTERVAL = 5. MINUTES
 1-HR TO 6-HR RATIO FOR ISOHYET A AT 20000 SQ. MI. = .270

		DEPTH VS. DURATION																	
ISOHYET		5MIN	10MIN	15MIN	30MIN	1-HR	2-HR	3-HR	6-HR	12-HR	18-HR	24-HR	30-HR	36-HR	42-HR	48-HR	54-HR	60-HR	66-HR
72-HR																			
A	1.78	3.56	5.32	10.24	16.44	20.92	24.45	31.29	38.69	42.40	44.89	46.77	48.29	49.55	50.63	51.58	52.43	53.19	
53.89	.36	.71	1.07	2.13	4.26	8.41	12.25	20.02	24.76	27.17	28.79	30.02	31.00	31.82	32.52	33.14	33.69	34.19	
B																			
34.64	.27	.53	.80	1.60	3.20	6.31	9.19	15.02	18.57	20.35	21.55	22.45	23.18	23.78	24.30	24.76	25.17	25.53	
C																			
25.87	.21	.42	.63	1.27	2.53	4.98	7.26	11.89	14.78	16.22	17.20	17.93	18.52	19.01	19.43	19.80	20.13	20.43	
D																			
20.70	.17	.33	.50	1.00	2.00	3.94	5.74	9.39	11.61	12.72	13.47	14.03	14.49	14.86	15.19	15.48	15.73	15.96	
E																			
16.17	.13	.27	.40	.80	1.60	3.15	4.59	7.51	9.29	10.18	10.77	11.23	11.59	11.89	12.15	12.38	12.58	12.77	
F																			
12.93																			

[illegible]

PROBABLE MAXIMUM STORM FOR LOWMAN

TIME	PRECIPITATION INCR	PRECIPITATION TOTAL	TIME	PRECIPITATION INCR	PRECIPITATION TOTAL	TIME	PRECIPITATION INCR	PRECIPITATION TOTAL	TIME	PRECIPITATION INCR	PRECIPITATION TOTAL
0005	.01	.01	0605	.01	.65	1205	.01	1.43	1805	.02	2.43
0010	.01	.02	0610	.01	.66	1210	.01	1.44	1810	.02	2.45
0015	.01	.03	0615	.01	.67	1215	.01	1.46	1815	.02	2.47
0020	.01	.04	0620	.01	.68	1220	.01	1.47	1820	.02	2.49
0025	.01	.04	0625	.01	.69	1225	.01	1.48	1825	.02	2.51
0030	.01	.05	0630	.01	.70	1230	.01	1.50	1830	.02	2.53
0035	.01	.06	0635	.01	.71	1235	.01	1.51	1835	.02	2.55
0040	.01	.07	0640	.01	.72	1240	.01	1.52	1840	.02	2.56
0045	.01	.08	0645	.01	.73	1245	.01	1.54	1845	.02	2.58
0050	.01	.09	0650	.01	.75	1250	.01	1.55	1850	.02	2.60
0055	.01	.10	0655	.01	.76	1255	.01	1.57	1855	.02	2.62
0100	.01	.11	0700	.01	.77	1300	.01	1.58	1900	.02	2.64

0105	.01	.12	0705	.01	LOWOUT .OUT	1305	.01	1.59	1905	.02	2.66
0110	.01	.12	0710	.01	.78	1310	.01	1.61	1910	.02	2.68
0115	.01	.13	0715	.01	.79	1315	.01	1.62	1915	.02	2.70
0120	.01	.14	0720	.01	.80	1320	.01	1.64	1920	.02	2.72
0125	.01	.15	0725	.01	.81	1325	.01	1.65	1925	.02	2.74
0130	.01	.16	0730	.01	.82	1330	.01	1.66	1930	.02	2.76
0135	.01	.17	0735	.01	.83	1335	.01	1.68	1935	.02	2.78
0140	.01	.18	0740	.01	.84	1340	.01	1.69	1940	.02	2.80
0145	.01	.19	0745	.01	.85	1345	.01	1.70	1945	.02	2.81
0150	.01	.19	0750	.01	.86	1350	.01	1.72	1950	.02	2.83
0155	.01	.20	0755	.01	.87	1355	.01	1.73	1955	.02	2.85
0200	.01	.21	0800	.01	.89	1400	.01	1.75	2000	.02	2.87
0205	.01	.22	0805	.01	.90	1405	.01	1.76	2005	.02	2.89
0210	.01	.22	0810	.01	.91	1410	.01	1.76	2010	.02	2.91
0215	.01	.23	0815	.01	.92	1415	.01	1.77	2015	.02	2.93
0220	.01	.24	0820	.01	.93	1420	.01	1.79	2020	.02	2.95
0225	.01	.25	0825	.01	.94	1425	.01	1.80	2025	.02	2.97
0230	.01	.26	0830	.01	.95	1430	.01	1.82	2030	.02	2.99
0235	.01	.27	0835	.01	.96	1435	.01	1.83	2035	.02	3.01
0240	.01	.27	0840	.01	.97	1440	.01	1.84	2040	.02	3.03
0245	.01	.28	0845	.01	.98	1445	.01	1.86	2045	.02	3.05
0250	.01	.29	0850	.01	.99	1450	.01	1.87	2050	.02	3.07
0255	.01	.30	0855	.01	1.00	1455	.01	1.88	2055	.02	3.08
0300	.01	.31	0900	.01	1.01	1500	.01	1.90	2100	.02	3.10
0305	.01	.32	0905	.01	1.03	1505	.01	1.91	2105	.02	3.12
0310	.01	.33	0910	.01	1.04	1510	.01	1.93	2110	.02	3.14
0315	.01	.34	0915	.01	1.05	1515	.01	1.94	2115	.02	3.16
0320	.01	.35	0920	.01	1.06	1520	.01	1.95	2120	.02	3.18
0325	.01	.35	0925	.01	1.07	1525	.01	1.97	2125	.02	3.20
0330	.01	.36	0930	.01	1.08	1530	.01	1.98	2130	.02	3.22
0335	.01	.37	0935	.01	1.09	1535	.01	2.00	2135	.02	3.24
0340	.01	.38	0940	.01	1.10	1540	.01	2.01	2140	.02	3.26
0345	.01	.39	0945	.01	1.11	1545	.01	2.02	2145	.02	3.28
0350	.01	.40	0950	.01	1.12	1550	.01	2.04	2150	.02	3.30
0355	.01	.41	0955	.01	1.13	1555	.01	2.05	2155	.02	3.32
0400	.01	.42	1000	.01	1.14	1600	.01	2.06	2200	.02	3.33
0405	.01	.42	1005	.01	1.16	1605	.01	2.08	2205	.02	3.35
0410	.01	.43	1010	.01	1.17	1610	.01	2.09	2210	.02	3.37
0415	.01	.44	1015	.01	1.18	1615	.01	2.11	2215	.02	3.39
0420	.01	.45	1020	.01	1.19	1620	.01	2.12	2220	.02	3.41
0425	.01	.46	1025	.01	1.20	1625	.01	2.13	2225	.02	3.43
0430	.01	.47	1030	.01	1.21	1630	.01	2.15	2230	.02	3.45
0435	.01	.48	1035	.01	1.22	1635	.01	2.16	2235	.02	3.47
0440	.01	.49	1040	.01	1.23	1640	.01	2.17	2240	.02	3.49
0445	.01	.50	1045	.01	1.24	1645	.01	2.19	2245	.02	3.51
0450	.01	.50	1050	.01	1.25	1650	.01	2.20	2250	.02	3.53
0455	.01	.51	1055	.01	1.26	1655	.01	2.22	2255	.02	3.55
0500	.01	.52	1100	.01	1.27	1700	.01	2.23	2300	.02	3.57
0505	.01	.53	1105	.01	1.28	1705	.01	2.24	2305	.02	3.59
0510	.01	.54	1110	.01	1.30	1710	.01	2.26	2310	.02	3.60
0515	.01	.55	1115	.01	1.31	1715	.01	2.27	2315	.02	3.62
0520	.01	.56	1120	.01	1.32	1720	.01	2.29	2320	.02	3.64
		.57			1.33						

				LOWOUT .OUT			
0525	.01	.58	1125	.01	1.34	1725	.01
0530	.01	.58	1130	.01	1.35	1730	.01
0535	.01	.59	1135	.01	1.36	1735	.01
0540	.01	.60	1140	.01	1.37	1740	.01
0545	.01	.61	1145	.01	1.38	1745	.01
0550	.01	.62	1150	.01	1.39	1750	.01
0555	.01	.63	1155	.01	1.40	1755	.01
0600	.01	.64	1200	.01	1.41	1800	.01
6-HR TOTAL	.64			.78			1.39

DAY 2	TIME	PRECIPITATION INCR	PRECIPITATION TOTAL	TIME	PRECIPITATION INCR	PRECIPITATION TOTAL	TIME	PRECIPITATION INCR	PRECIPITATION TOTAL
	0005	.03	3.82		.06	6.15	1205	.13	13.00
	0010	.03	3.85		.06	6.21	1210	.14	13.14
	0015	.03	3.88		.07	6.28	1215	.15	13.29
	0020	.03	3.91		.07	6.34	1220	.16	13.45
	0025	.03	3.94		.07	6.41	1225	.17	13.61
	0030	.03	3.96		.07	6.48	1230	.17	13.79
	0035	.03	3.99		.07	6.55	1235	.18	13.97
	0040	.03	4.02		.07	6.62	1240	.19	14.16
	0045	.03	4.05		.07	6.69	1245	.20	14.36
	0050	.03	4.07		.07	6.76	1250	.20	14.56
	0055	.03	4.10		.07	6.83	1255	.21	14.77
	0100	.03	4.13		.07	6.90	1300	.21	14.98
	0105	.03	4.16		.07	6.98	1305	.22	15.20
	0110	.03	4.19		.07	7.05	1310	.22	15.42
	0115	.03	4.22		.08	7.13	1315	.23	15.64
	0120	.03	4.25		.08	7.20	1320	.23	15.87
	0125	.03	4.27		.08	7.28	1325	.23	16.10
	0130	.03	4.30		.08	7.36	1330	.23	16.33
	0135	.03	4.33		.08	7.43	1335	.24	16.58
	0140	.03	4.36		.08	7.51	1340	.27	16.85
	0145	.03	4.39		.08	7.59	1345	.29	17.14
	0150	.03	4.42		.08	7.68	1350	.31	17.45
	0155	.03	4.45		.08	7.76	1355	.32	17.77
	0200	.03	4.48		.08	7.84	1400	.33	18.09
	0205	.03	4.51		.08	7.92	1405	.33	18.41
	0210	.03	4.54		.08	8.01	1410	.31	18.72
	0215	.03	4.57		.09	8.09	1415	.32	19.04
	0220	.03	4.60		.09	8.18	1420	.34	19.39
	0225	.03	4.63		.09	8.27	1425	.39	19.78
	0230	.03	4.66		.09	8.36	1430	.46	20.23
	0235	.03	4.69		.09	8.45	1435	.60	20.84
	0240	.03	4.72		.09	8.54	1440	.88	21.71
	0245	.03	4.75		.09	8.63	1445	1.03	22.74
	0250	.03	4.78		.09	8.72	1450	1.22	23.96
	0255	.03	4.81		.09	8.81	1455	1.44	25.40

LOWOUT .OUT											
0300	.03	4.85	0900	.09	8.90	1500	1.47	26.87	2100	.05	43.46
0305	.03	4.88	0905	.09	9.00	1505	1.46	28.33	2105	.05	43.51
0310	.03	4.91	0910	.10	9.09	1510	1.45	29.78	2110	.05	43.55
0315	.03	4.94	0915	.10	9.19	1515	1.41	31.20	2115	.04	43.60
0320	.03	4.97	0920	.10	9.29	1520	1.06	32.26	2120	.04	43.64
0325	.03	5.00	0925	.10	9.39	1525	.97	33.23	2125	.04	43.69
0330	.03	5.04	0930	.10	9.48	1530	.75	33.98	2130	.04	43.73
0335	.03	5.07	0935	.10	9.58	1535	.49	34.48	2135	.04	43.77
0340	.03	5.10	0940	.10	9.68	1540	.42	34.90	2140	.04	43.82
0345	.03	5.13	0945	.10	9.79	1545	.37	35.26	2145	.04	43.86
0350	.03	5.17	0950	.10	9.89	1550	.33	35.59	2150	.04	43.90
0355	.03	5.20	0955	.10	9.99	1555	.31	35.90	2155	.04	43.95
0400	.03	5.23	1000	.10	10.10	1600	.31	36.22	2200	.04	43.99
0405	.03	5.27	1005	.11	10.20	1605	.33	36.54	2205	.04	44.03
0410	.03	5.30	1010	.11	10.31	1610	.32	36.87	2210	.04	44.07
0415	.03	5.33	1015	.11	10.41	1615	.31	37.18	2215	.04	44.11
0420	.03	5.37	1020	.11	10.52	1620	.30	37.48	2220	.04	44.15
0425	.03	5.40	1025	.11	10.63	1625	.28	37.76	2225	.04	44.20
0430	.03	5.44	1030	.11	10.74	1630	.26	38.02	2230	.04	44.24
0435	.03	5.47	1035	.11	10.85	1635	.23	38.25	2235	.04	44.28
0440	.03	5.51	1040	.11	10.96	1640	.23	38.49	2240	.04	44.32
0445	.03	5.54	1045	.11	11.07	1645	.23	38.72	2245	.04	44.36
0450	.04	5.57	1050	.11	11.19	1650	.23	38.94	2250	.04	44.40
0455	.04	5.61	1055	.11	11.30	1655	.22	39.17	2255	.04	44.44
0500	.04	5.65	1100	.12	11.42	1700	.22	39.39	2300	.04	44.48
0505	.04	5.68	1105	.12	11.53	1705	.22	39.60	2305	.04	44.52
0510	.04	5.72	1110	.12	11.65	1710	.21	39.81	2310	.04	44.55
0515	.04	5.75	1115	.12	11.77	1715	.20	40.02	2315	.04	44.59
0520	.04	5.79	1120	.12	11.89	1720	.20	40.22	2320	.04	44.63
0525	.04	5.83	1125	.12	12.01	1725	.19	40.41	2325	.04	44.67
0530	.04	5.86	1130	.12	12.13	1730	.19	40.59	2330	.04	44.71
0535	.04	5.90	1135	.12	12.25	1735	.18	40.77	2335	.04	44.75
0540	.04	5.94	1140	.12	12.37	1740	.17	40.94	2340	.04	44.79
0545	.04	5.97	1145	.12	12.50	1745	.16	41.10	2345	.04	44.83
0550	.04	6.01	1150	.12	12.62	1750	.15	41.26	2350	.04	44.86
0555	.04	6.05	1155	.13	12.75	1755	.14	41.40	2355	.04	44.90
0600	.04	6.09	1200	.13	12.87	1800	.13	41.54	2400	.04	44.94
6-HR TOTAL	2.29		6.79		28.66				3.40		

DAY 3		PRECIPITATION		PRECIPITATION		PRECIPITATION		PRECIPITATION		PRECIPITATION		PRECIPITATION	
TIME	INCR	TOTAL	TIME	INCR	TOTAL	TIME	INCR	TOTAL	TIME	INCR	TOTAL	TIME	TOTAL
0005	.02	44.96	0605	.02	46.68	1205	.01	47.84	1805	.01	48.71		
0010	.02	44.99	0610	.02	46.70	1210	.01	47.85	1810	.01	48.72		
0015	.02	45.01	0615	.02	46.72	1215	.01	47.86	1815	.01	48.73		
0020	.02	45.04	0620	.02	46.73	1220	.01	47.87	1820	.01	48.74		
0025	.02	45.06	0625	.02	46.75	1225	.01	47.89	1825	.01	48.75		
0030	.02	45.08	0630	.02	46.76	1230	.01	47.90	1830	.01	48.76		

LOWOUT .OUT

0035	.02	45.11	0635	.02	46.78	.01	47.91	1835	.01	48.77
0040	.02	45.13	0640	.02	46.80	.01	47.92	1840	.01	48.78
0045	.02	45.16	0645	.02	46.81	.01	47.94	1845	.01	48.79
0050	.02	45.18	0650	.02	46.83	.01	47.95	1850	.01	48.80
0055	.02	45.20	0655	.02	46.84	.01	47.96	1855	.01	48.81
0100	.02	45.23	0700	.02	46.86	.01	47.97	1900	.01	48.82
0105	.02	45.25	0705	.02	46.88	.01	47.98	1905	.01	48.83
0110	.02	45.28	0710	.02	46.89	.01	48.00	1910	.01	48.84
0115	.02	45.30	0715	.02	46.91	.01	48.01	1915	.01	48.84
0120	.02	45.32	0720	.02	46.92	.01	48.02	1920	.01	48.85
0125	.02	45.35	0725	.02	46.94	.01	48.03	1925	.01	48.86
0130	.02	45.37	0730	.02	46.96	.01	48.04	1930	.01	48.87
0135	.02	45.40	0735	.02	46.97	.01	48.06	1935	.01	48.88
0140	.02	45.42	0740	.02	46.99	.01	48.07	1940	.01	48.89
0145	.02	45.44	0745	.02	47.01	.01	48.08	1945	.01	48.90
0150	.02	45.47	0750	.02	47.02	.01	48.09	1950	.01	48.91
0155	.02	45.49	0755	.02	47.04	.01	48.11	1955	.01	48.92
0200	.02	45.52	0800	.02	47.05	.01	48.12	2000	.01	48.93
0205	.02	45.54	0805	.02	47.07	.01	48.13	2005	.01	48.94
0210	.02	45.56	0810	.02	47.09	.01	48.14	2010	.01	48.95
0215	.02	45.59	0815	.02	47.10	.01	48.15	2015	.01	48.96
0220	.02	45.61	0820	.02	47.12	.01	48.17	2020	.01	48.97
0225	.02	45.64	0825	.02	47.13	.01	48.18	2025	.01	48.98
0230	.02	45.66	0830	.02	47.15	.01	48.19	2030	.01	48.99
0235	.02	45.68	0835	.02	47.17	.01	48.20	2035	.01	49.00
0240	.02	45.71	0840	.02	47.18	.01	48.21	2040	.01	49.01
0245	.02	45.73	0845	.02	47.20	.01	48.23	2045	.01	49.02
0250	.02	45.76	0850	.02	47.21	.01	48.24	2050	.01	49.03
0255	.02	45.78	0855	.02	47.23	.01	48.25	2055	.01	49.04
0300	.02	45.80	0900	.02	47.25	.01	48.26	2100	.01	49.05
0305	.02	45.83	0905	.02	47.26	.01	48.27	2105	.01	49.06
0310	.02	45.85	0910	.02	47.28	.01	48.29	2110	.01	49.07
0315	.02	45.88	0915	.02	47.29	.01	48.30	2115	.01	49.08
0320	.02	45.90	0920	.02	47.31	.01	48.31	2120	.01	49.09
0325	.02	45.92	0925	.02	47.33	.01	48.32	2125	.01	49.10
0330	.02	45.95	0930	.02	47.34	.01	48.34	2130	.01	49.11
0335	.02	45.97	0935	.02	47.36	.01	48.35	2135	.01	49.12
0340	.02	46.00	0940	.02	47.38	.01	48.36	2140	.01	49.13
0345	.02	46.02	0945	.02	47.39	.01	48.37	2145	.01	49.14
0350	.02	46.04	0950	.02	47.41	.01	48.38	2150	.01	49.15
0355	.02	46.07	0955	.02	47.42	.01	48.40	2155	.01	49.16
0400	.02	46.09	1000	.02	47.44	.01	48.41	2200	.01	49.17
0405	.02	46.12	1005	.02	47.46	.01	48.42	2205	.01	49.18
0410	.02	46.14	1010	.02	47.47	.01	48.43	2210	.01	49.19
0415	.02	46.16	1015	.02	47.49	.01	48.44	2215	.01	49.20
0420	.02	46.19	1020	.02	47.50	.01	48.46	2220	.01	49.20
0425	.02	46.21	1025	.02	47.52	.01	48.47	2225	.01	49.21
0430	.02	46.24	1030	.02	47.54	.01	48.48	2230	.01	49.22
0435	.02	46.26	1035	.02	47.55	.01	48.49	2235	.01	49.23
0440	.02	46.28	1040	.02	47.57	.01	48.51	2240	.01	49.24
0445	.02	46.31	1045	.02	47.58	.01	48.52	2245	.01	49.25
0450	.02	46.33	1050	.02	47.60	.01	48.53	2250	.01	49.26

0455	.02	46.36	1055	.02	47.62	LOWOUT.OUT	1655	.01	48.54	2255	.01	49.27
0500	.02	46.38	1100	.02	47.63		1700	.01	48.55	2300	.01	49.28
0505	.02	46.40	1105	.02	47.65		1705	.01	48.57	2305	.01	49.29
0510	.02	46.43	1110	.02	47.67		1710	.01	48.58	2310	.01	49.30
0515	.02	46.45	1115	.02	47.68		1715	.01	48.59	2315	.01	49.31
0520	.02	46.48	1120	.02	47.70		1720	.01	48.60	2320	.01	49.32
0525	.02	46.50	1125	.02	47.71		1725	.01	48.61	2325	.01	49.33
0530	.02	46.52	1130	.02	47.73		1730	.01	48.63	2330	.01	49.34
0535	.02	46.55	1135	.02	47.75		1735	.01	48.64	2335	.01	49.35
0540	.02	46.57	1140	.02	47.76		1740	.01	48.65	2340	.01	49.36
0545	.02	46.59	1145	.02	47.78		1745	.01	48.66	2345	.01	49.37
0550	.02	46.62	1150	.02	47.79		1750	.01	48.67	2350	.01	49.38
0555	.02	46.64	1155	.02	47.81		1755	.01	48.69	2355	.01	49.39
0600	.02	46.67	1200	.02	47.83		1800	.01	48.70	2400	.01	49.40
6-HR TOTAL	1.73			1.16				.87			.70	

APPENDIX

B

HEC-HMS Scenario Results

Site Pump Information

As provided by Owner

Information provided by Owner:

Name of Pond	Pump Rate	Water Outflows	Freeboard	Depth
SPD-1(Unit-1 Ash pond)	800gpm	800gpm/24hpd/30dpy	6 ft	14 ft
SPD-2(Unit2&3 Ash pond)	825gpm	230,000gpd/305dpy	3 ft	22 ft
SPD-3(FGD Pond)	1,400gpm	800,000gpd/342dpy	4 ft	22 ft
SPD-4(Process Waste Pond)	1,400gpm	763mgpy/362dpy	5 ft	27 ft
SPD-5(Coal Pile Runoff Pond)	1,000gpm	1.44mgpd/140dpy	5 ft	13 ft

Name of Pond	Source of Inflows	Inflow Amounts
SPD-1(Unit-1 Ash pond)	Bottom Ash Sluice	1,700gpm/12hpd/ 365dpy
SPD-2(Unit2&3 Ash pond)	#2 Lift Station	500gpm/2.5mgpd/365dpy
SPD-3(FGD pond)	Limestone Ball Mill Sump	9,000gpd/365dpy
	Sumps in FDG Plant/Gypsum Plant	465gpm/0.67mgpd/325dpy
	JBR Area Sump	210gpm/24hpd/325dpy
SPD-4(Process Waste Pond)	#1 Lift Station	0.5mgpd/320dpy
SPD-5(Coal Pile Runoff Pond)	Multiple Sources	No regular in flows

GPM=Gallons per Minute

HPD= Hours per Day

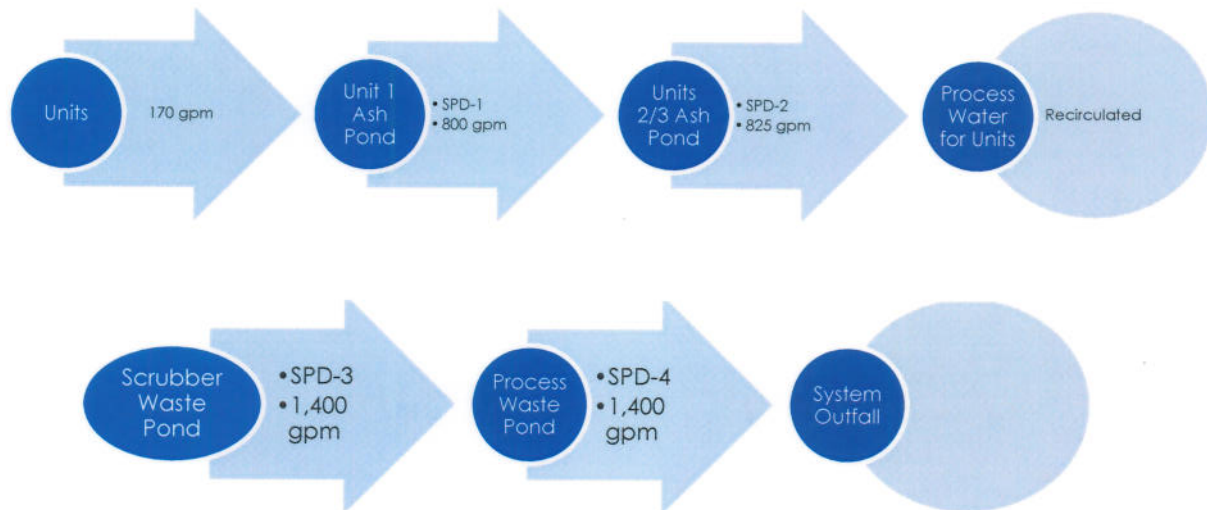
DPY= Days per Year

MGPY= Million Gallons per Year

MGPD= Million Gallons per Day

Scenario No. 1

HEC-HMS Scenario Results

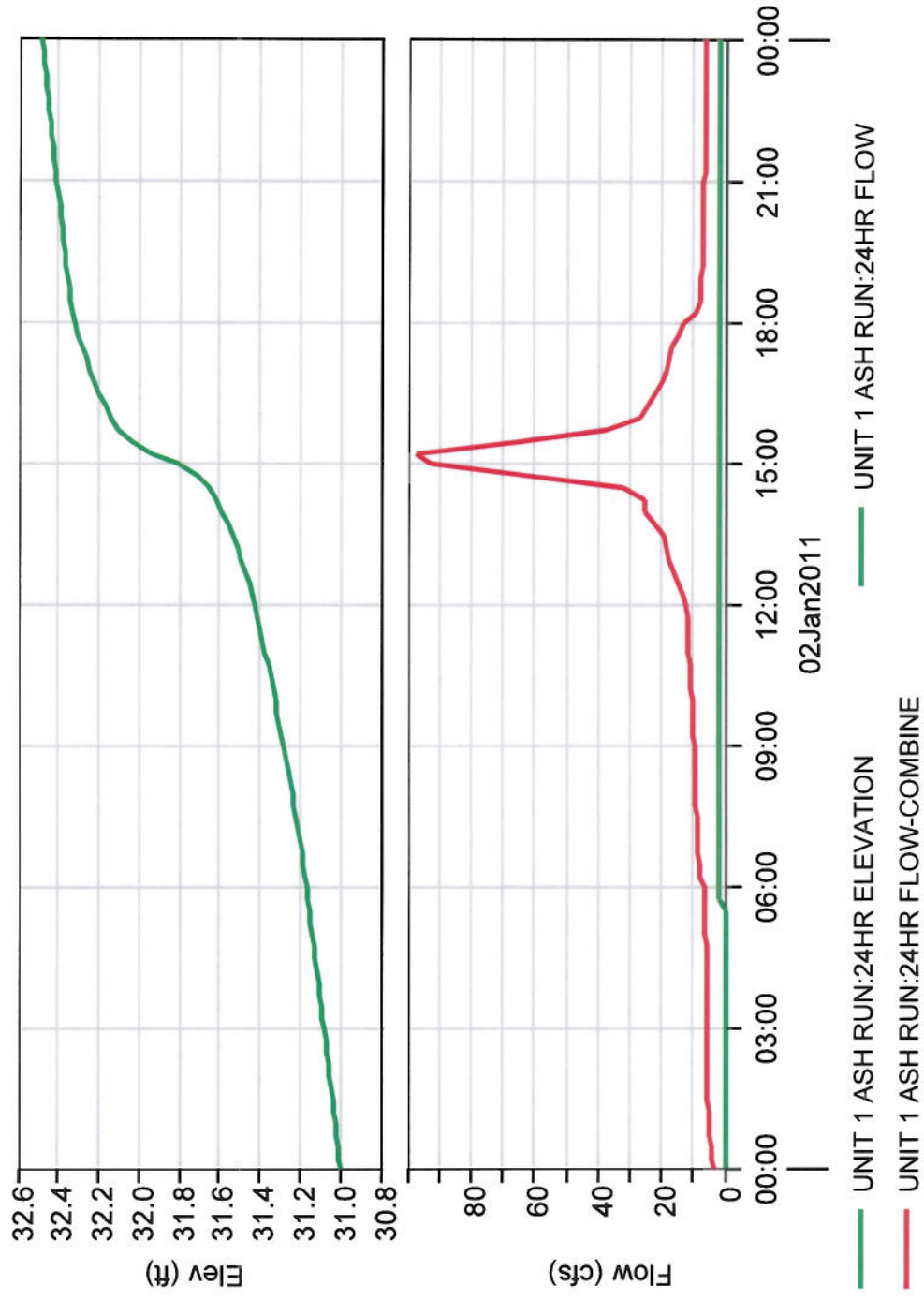


Scenario No. 1

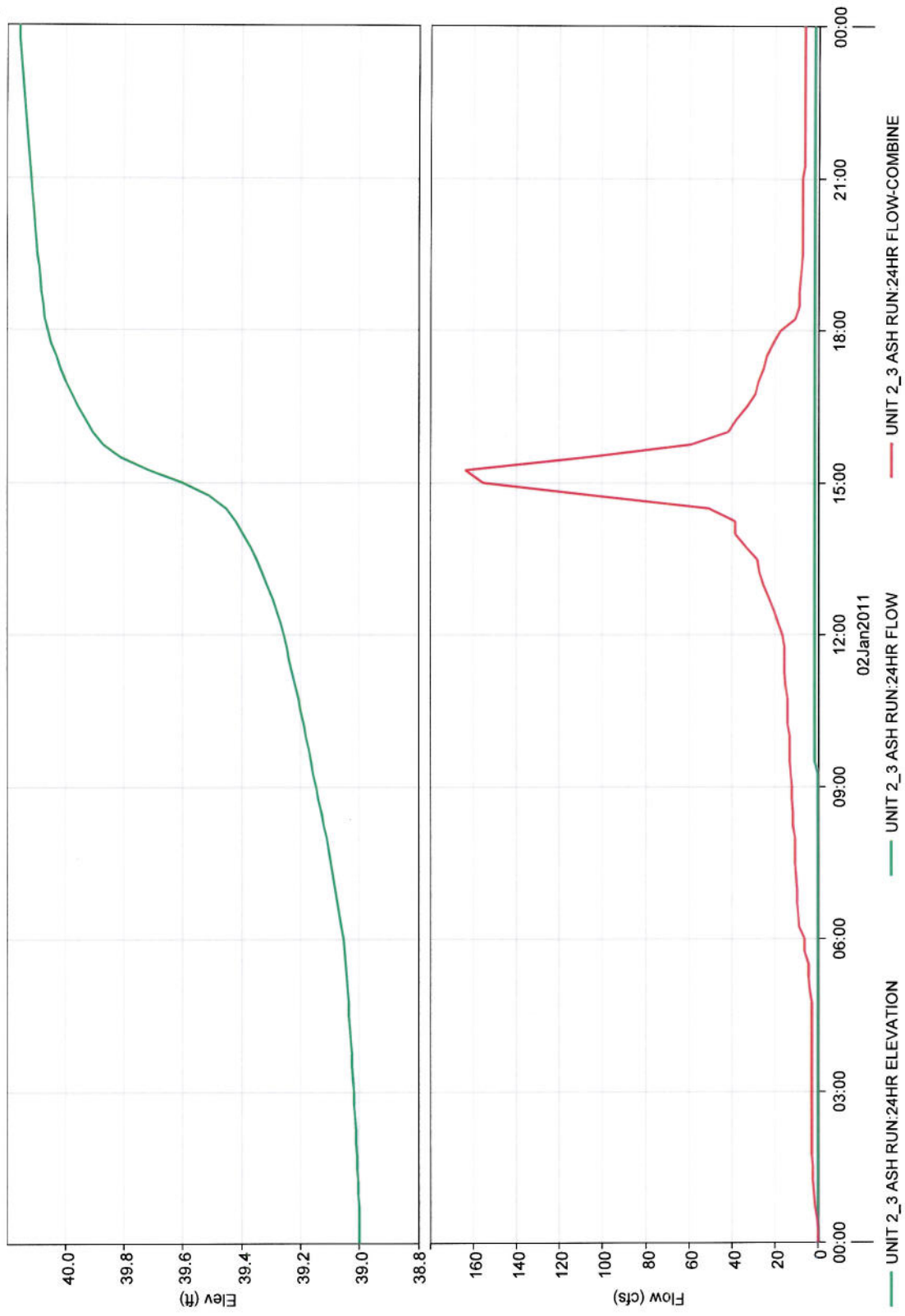
24hr Rain Event

HEC-HMS Scenario Results

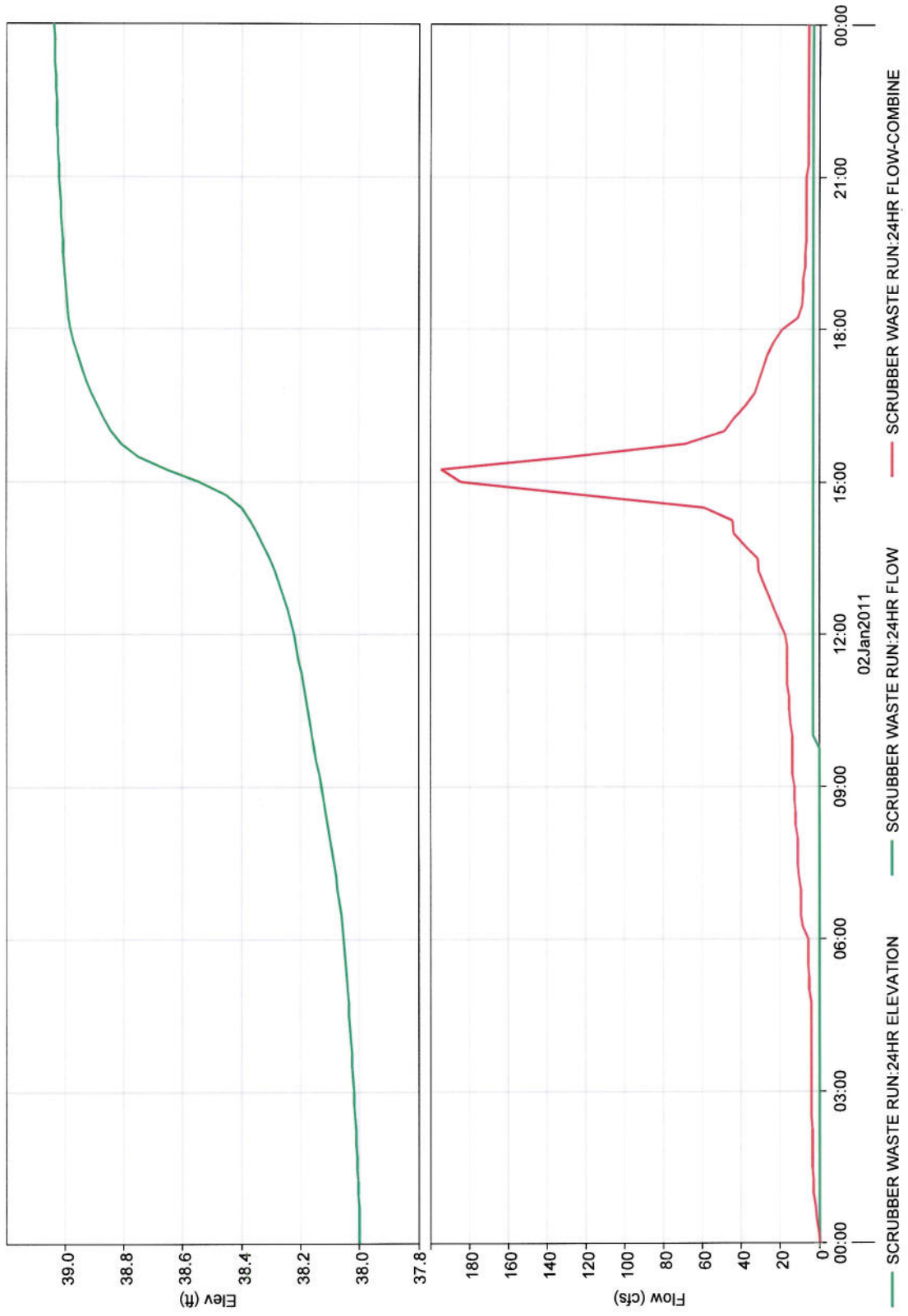
Scenario No.1
Unit 1 Ash Pond
24hr Event



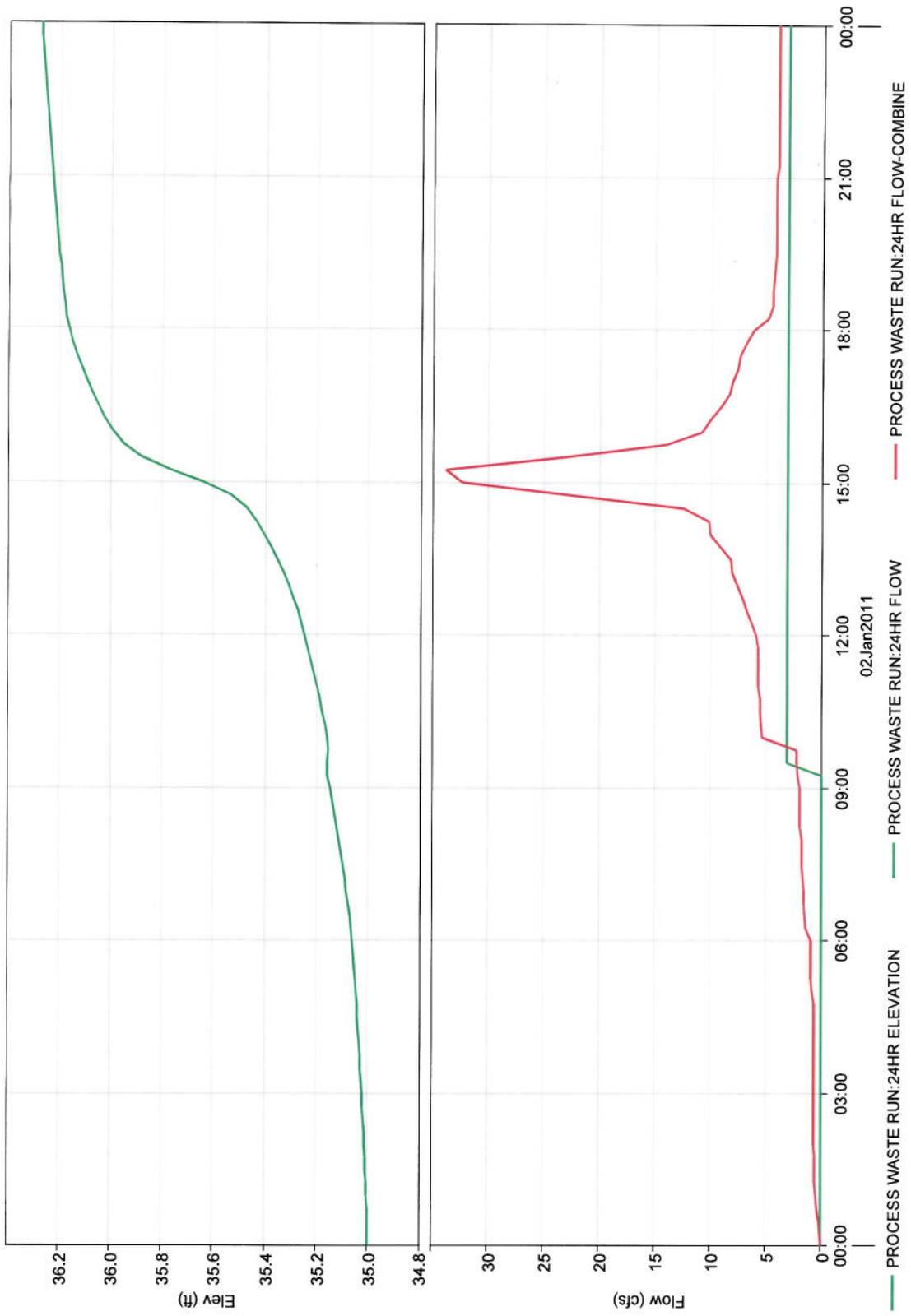
Scenario No.1
Unit 2/3 Ash Pond
24hr Event



Scenario No.1
Scrubber Waste Pond
24hr Event



Scenario No.1
Process Waste Pond
24hr Event

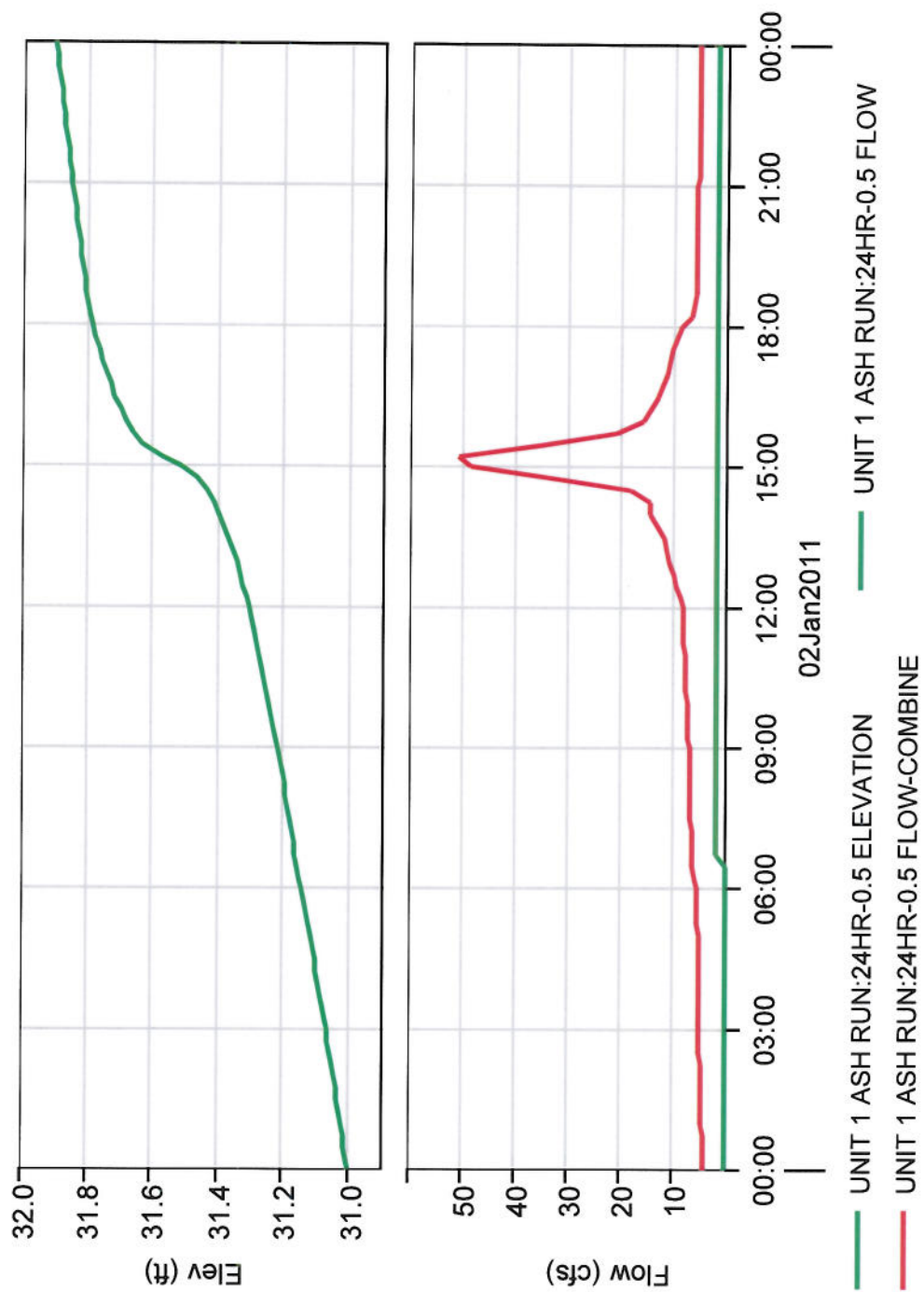


Scenario No. 1

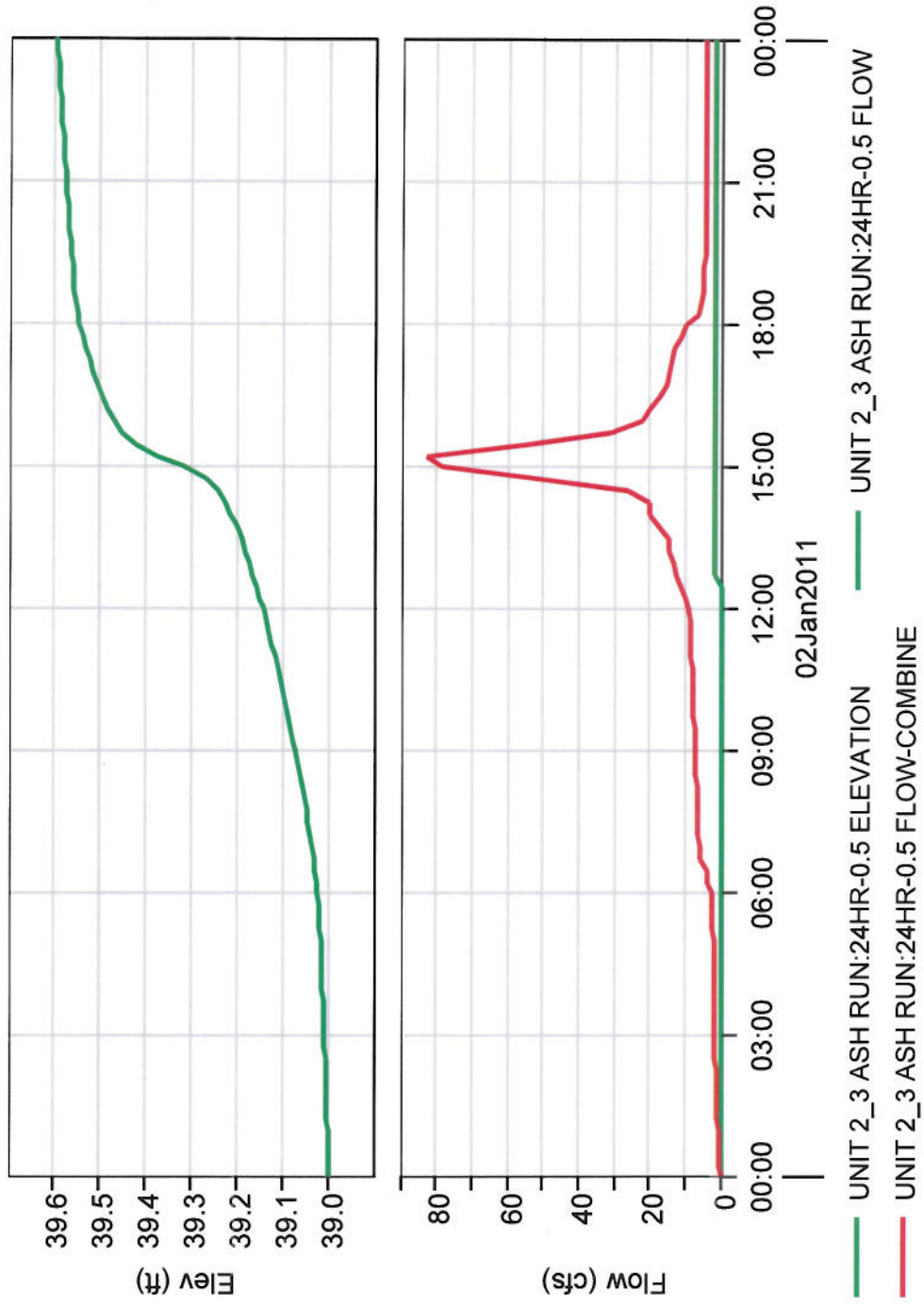
24hr Rain Event-50% PMP

HEC-HMS Scenario Results

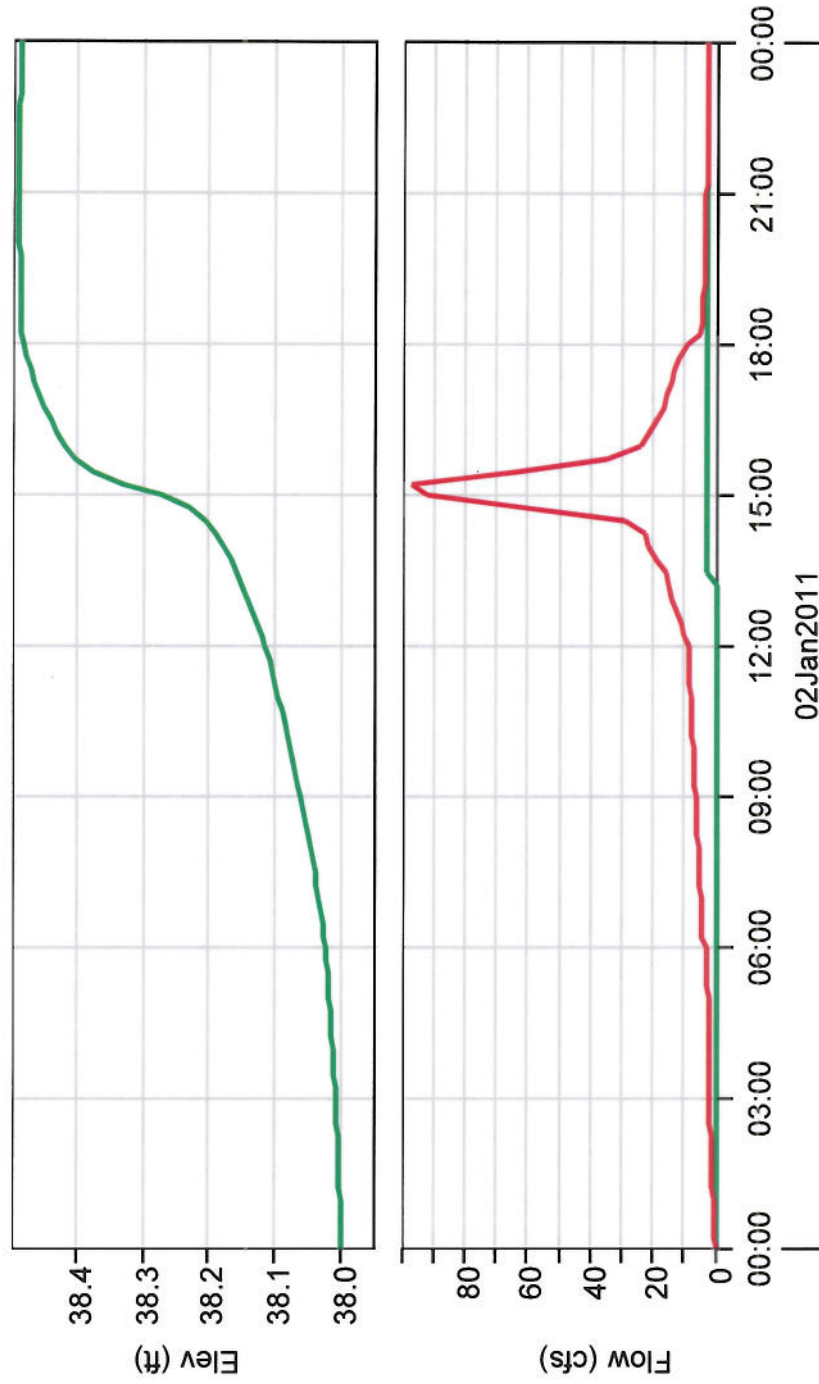
Scenario No.1
Unit 1 Ash Pond
24hr Event-50% PMP



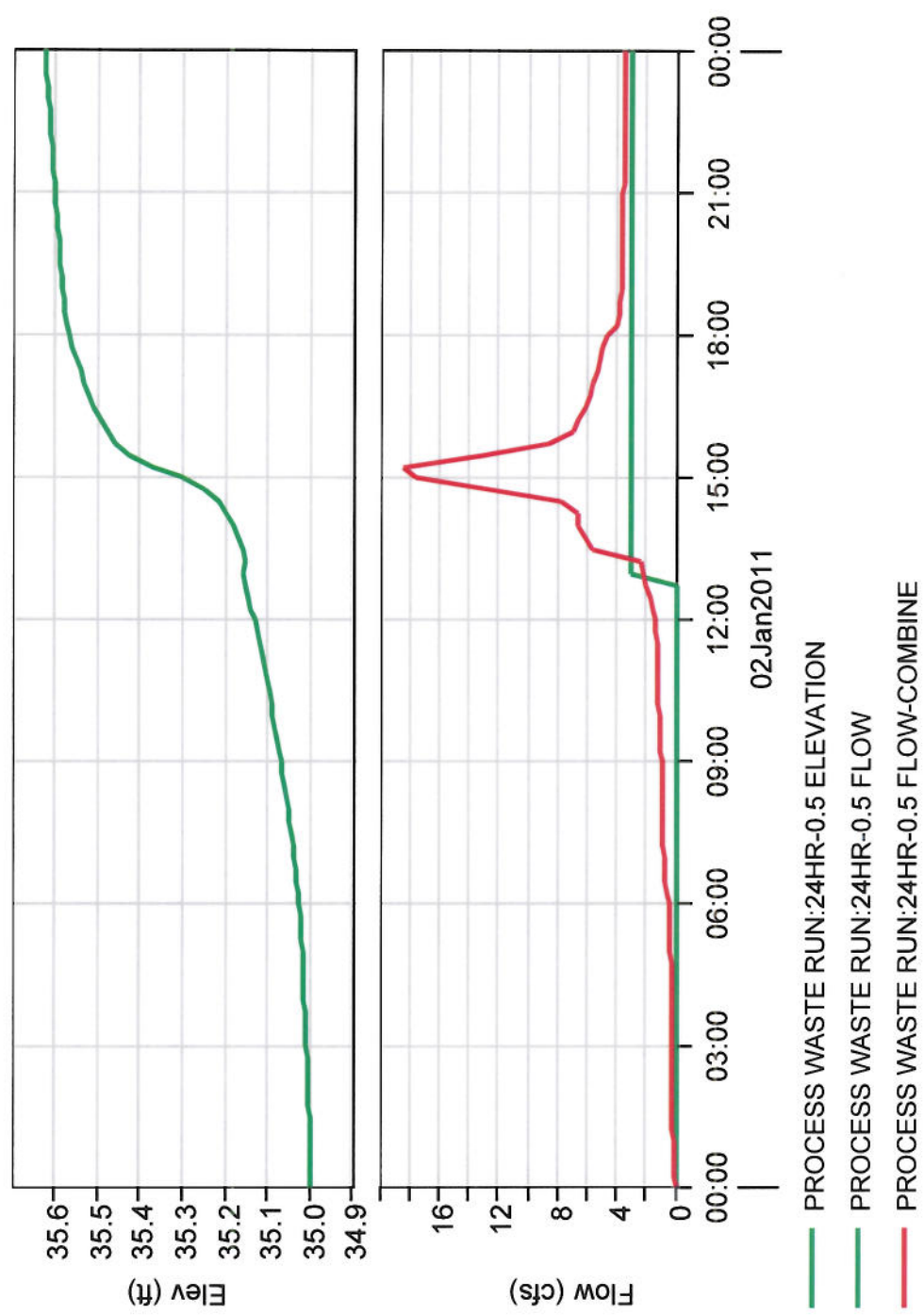
Scenario No.1
Unit 2/3 Ash Pond
24hr Event-50% PMP



Scenario No.1
Scrubber Waste Pond
24hr Event-50% PMP



Scenario No.1
Process Waste Pond
24hr Event-50% PMP



Scenario No. 1

72hr Rain Event

HEC-HMS Scenario Results

The figure consists of two vertically stacked time-series plots sharing a common x-axis representing time from 00:00 on 01Jan2011 to 00:00 on 03Jan2011.

The top plot displays Elevation (ft) on the y-axis, ranging from 30 to 37. It features a green line representing 'UNIT 1 ASH RUN:72HR ELEVATION' and a red line representing 'UNIT 1 ASH RUN:72HR FLOW-COMBINE'. The green line shows a steady increase in elevation from approximately 31.2 ft to 36.5 ft over the period. The red line is nearly identical to the green line, indicating a very close correlation between the two data series.

The bottom plot displays Flow (cfs) on the y-axis, ranging from 0 to 250. It features a green line representing 'UNIT 1 ASH RUN:72HR ELEVATION' and a red line representing 'UNIT 1 ASH RUN:72HR FLOW-COMBINE'. The green line remains at 0 cfs throughout the entire period. The red line shows a sharp peak in flow, reaching approximately 250 cfs, around 12:00 on 02Jan2011, before returning to 0 cfs.

UNIT 1 ASH RUN:72HR ELEVATION

UNIT 1 ASH RUN:72HR FLOW-COMBINE

Scenario No.1
2/3 Ash Pond
72hr Event



Scenario No.1
Scrubber Waste Pond
72hr Event



Scenario No.1
Process Waste Pond
72hr Event



Scenario No. 1

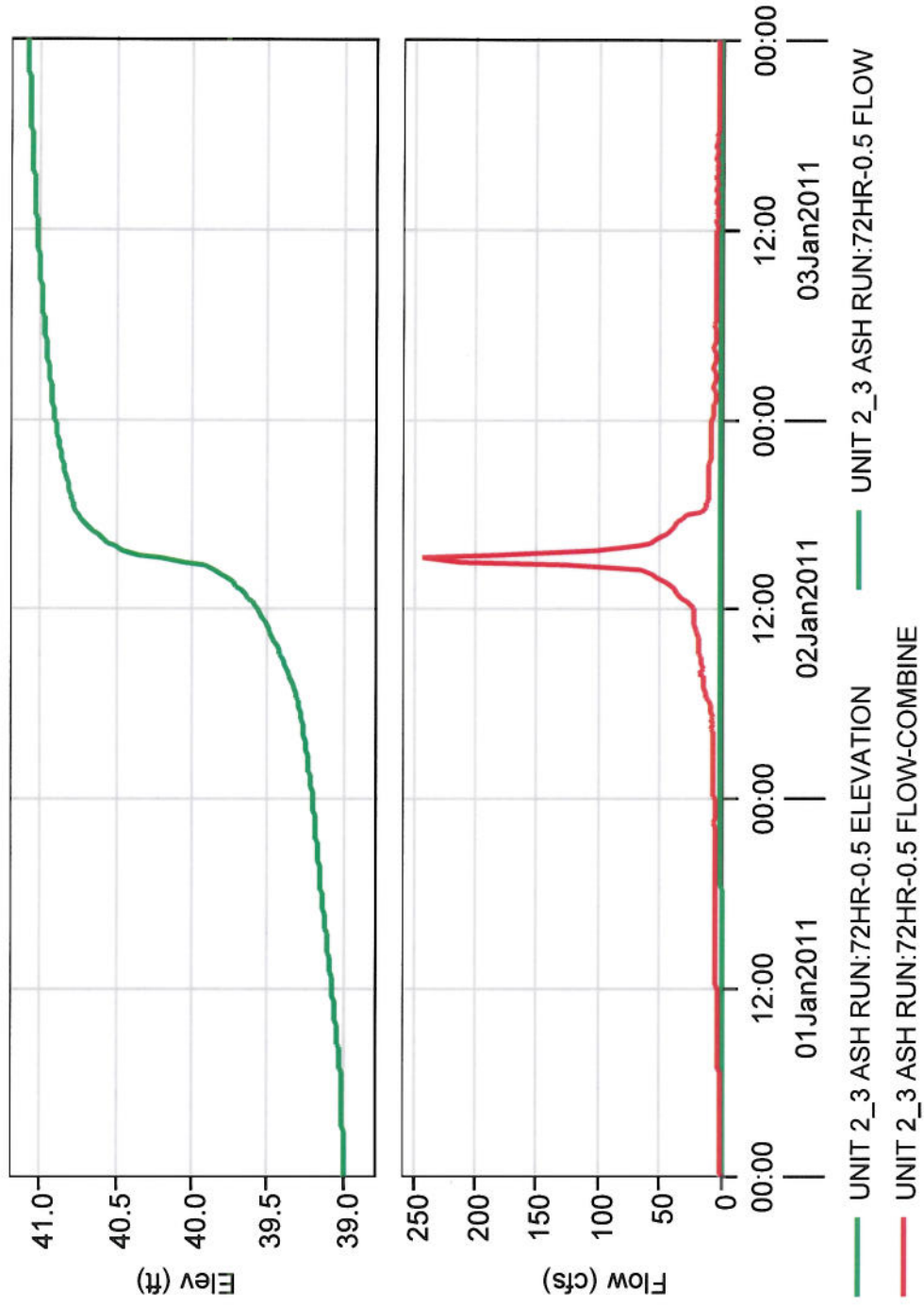
72hr Rain Event-50% PMP

HEC-HMS Scenario Results

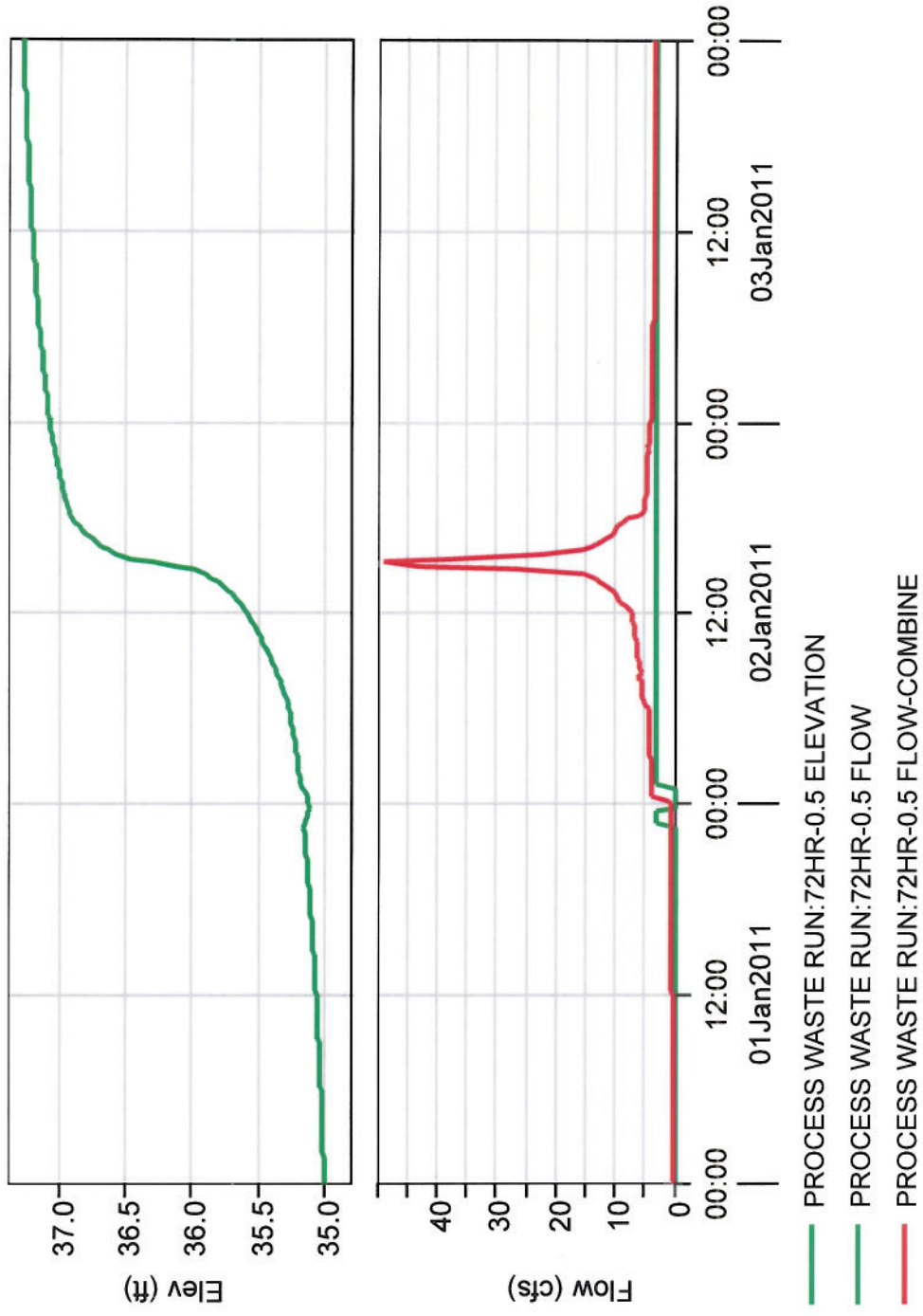
Scenario No.1
Unit 1 Ash Pond
72hr Event-50% PMP



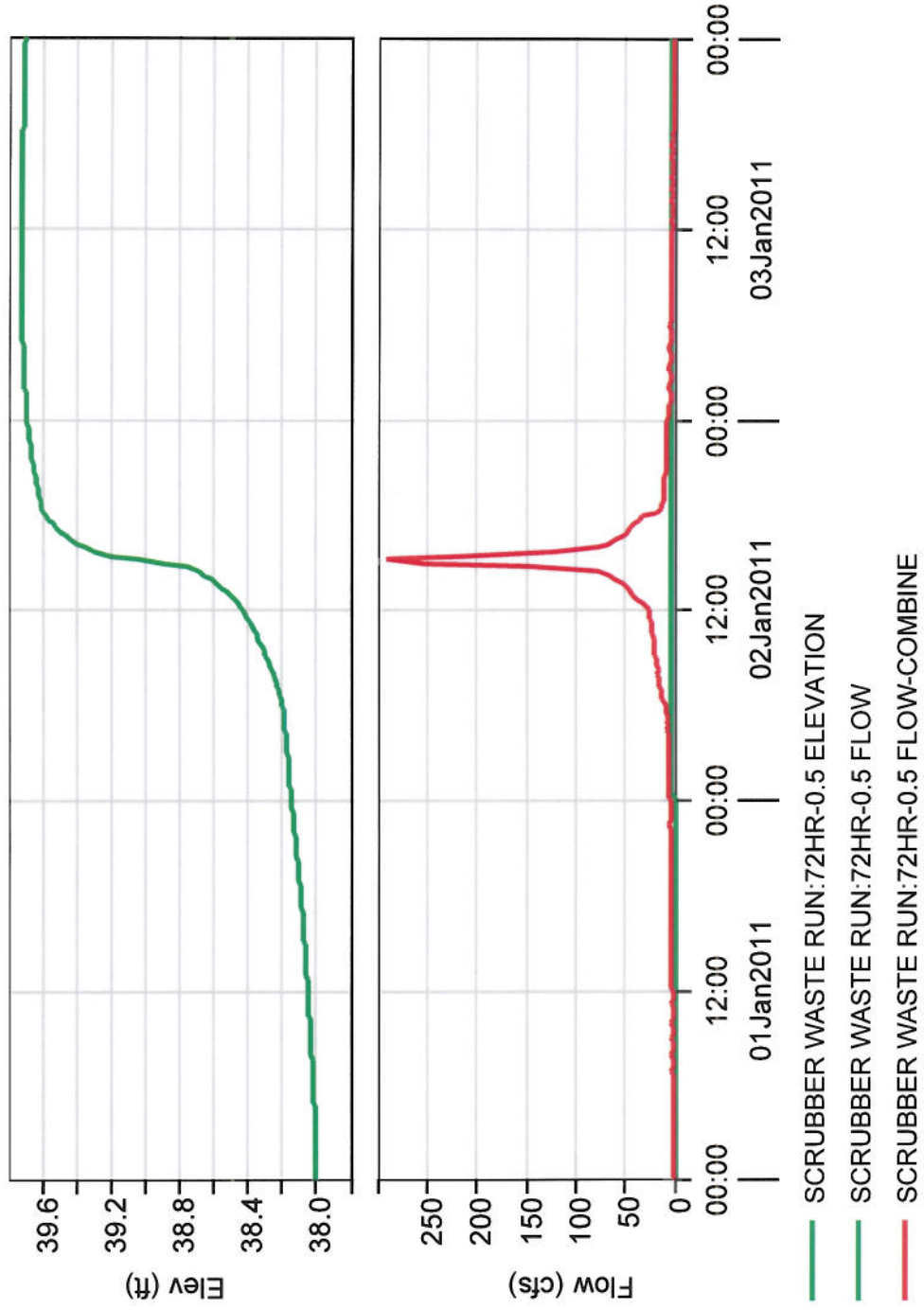
Scenario No.1
Unit 2/3 Ash Pond
72hr Event-50% PMP



Scenario No.1
Process Waste Pond
72hr Event-50% PMP

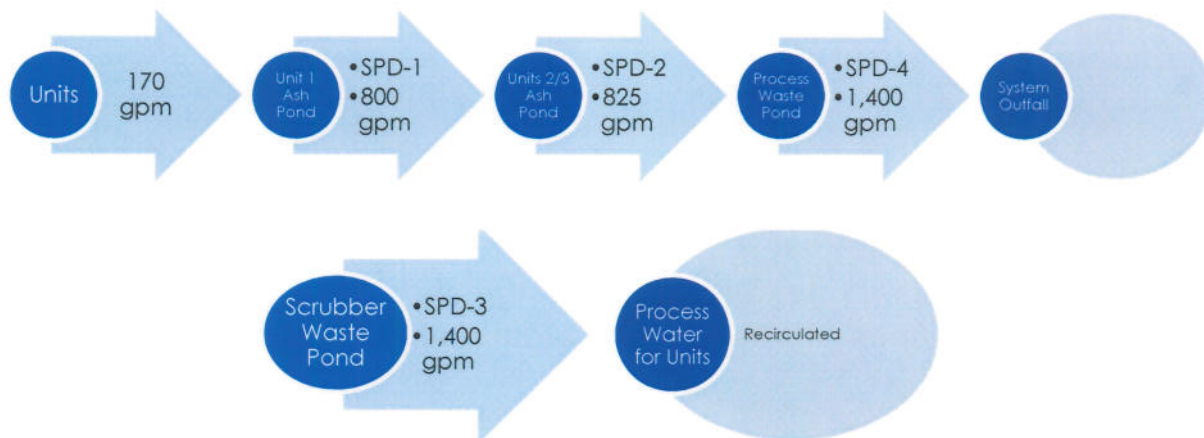


Scenario No.1
Scrubber Waste Pond
72hr Event-50% PMP



Scenario No. 2

HEC-HMS Scenario Results



Scenario No. 2

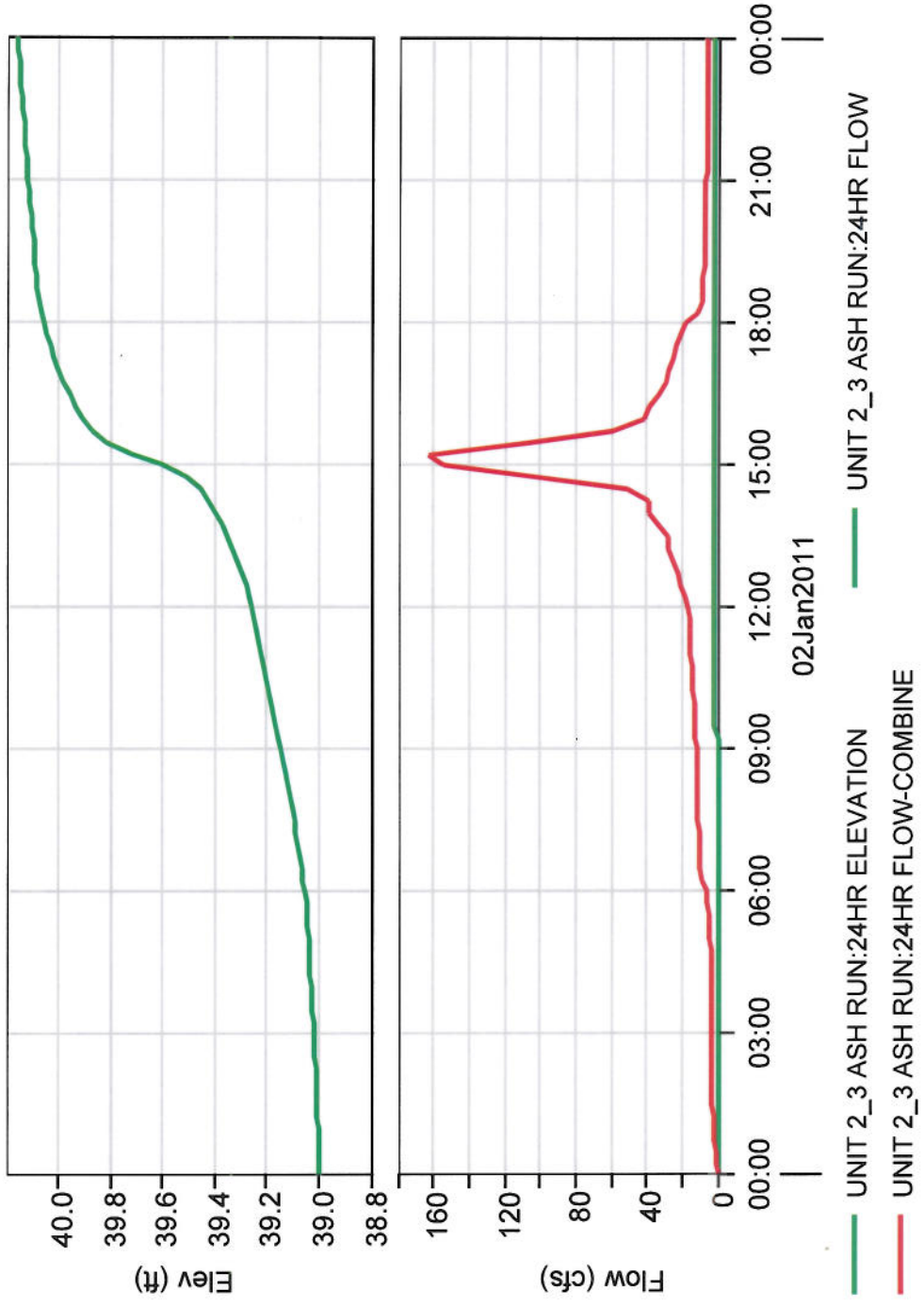
24hr Rain Event

HEC-HMS Scenario Results

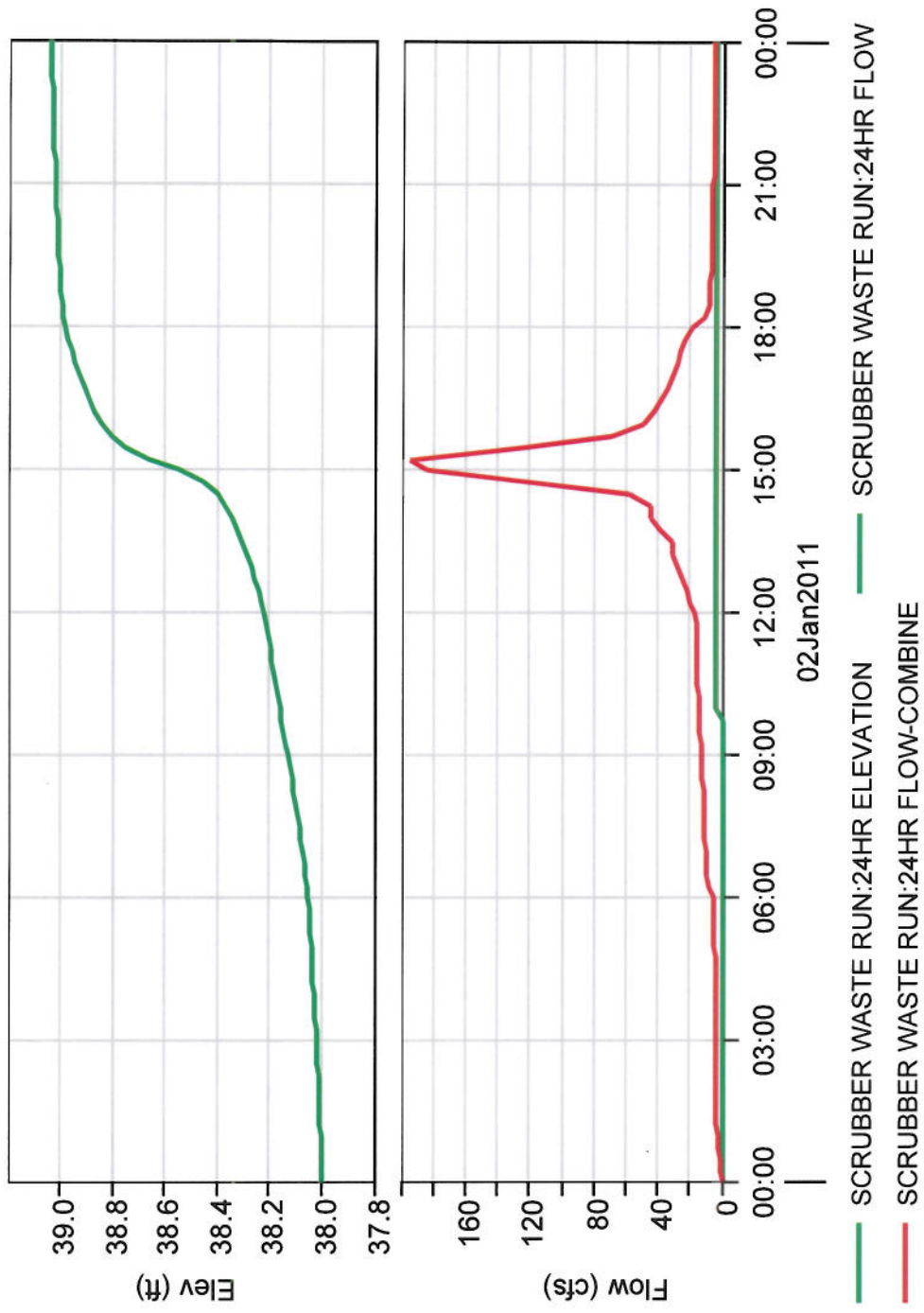
Scenario No.2
Unit 1 Ash Pond
24hr Event



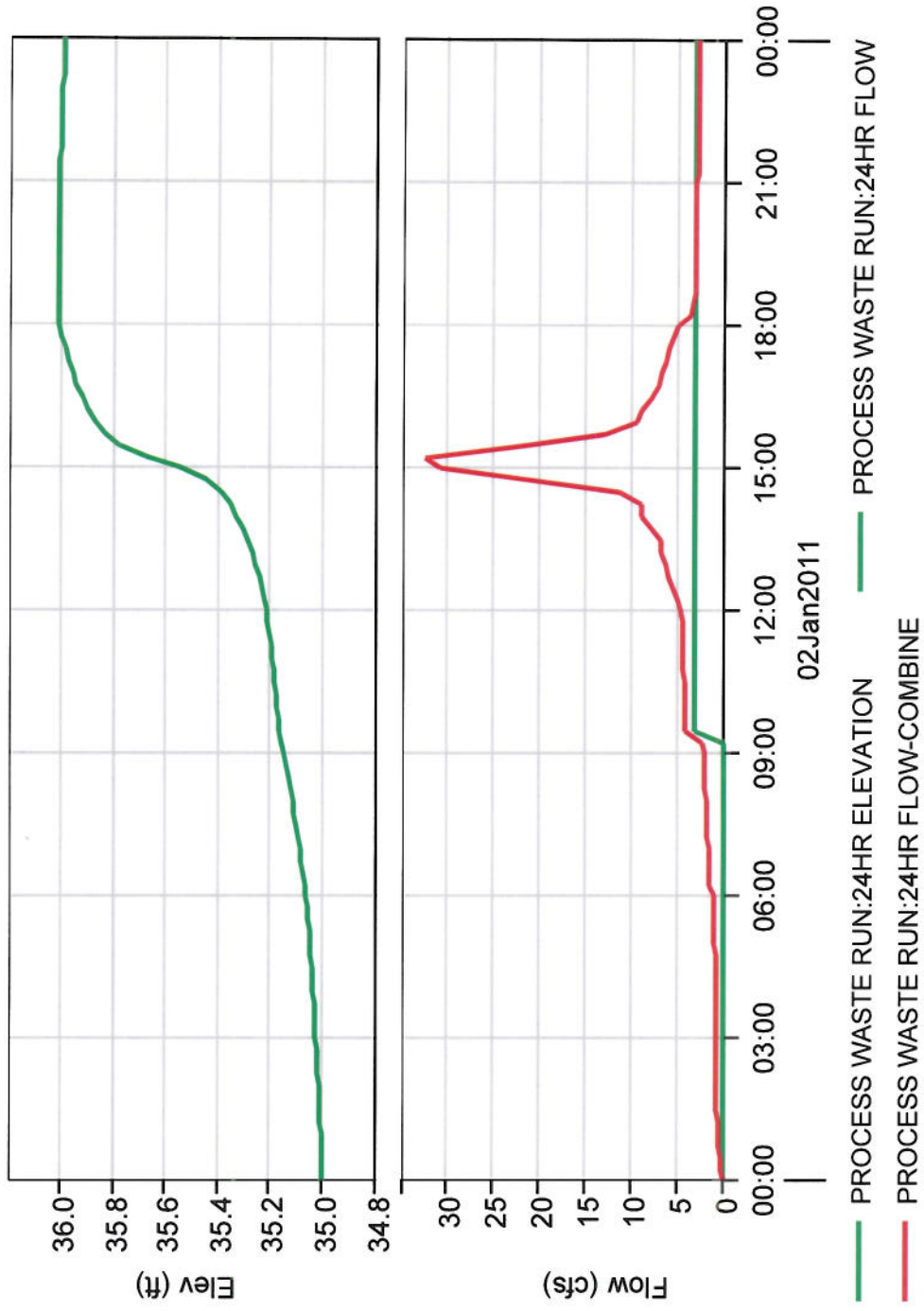
Scenario No.2
Unit 2/3 Ash Pond
24hr Event



Scenario No.2
Scrubber Waste Pond
24hr Event



Scenario No.2
Process Waste Pond
24hr Event

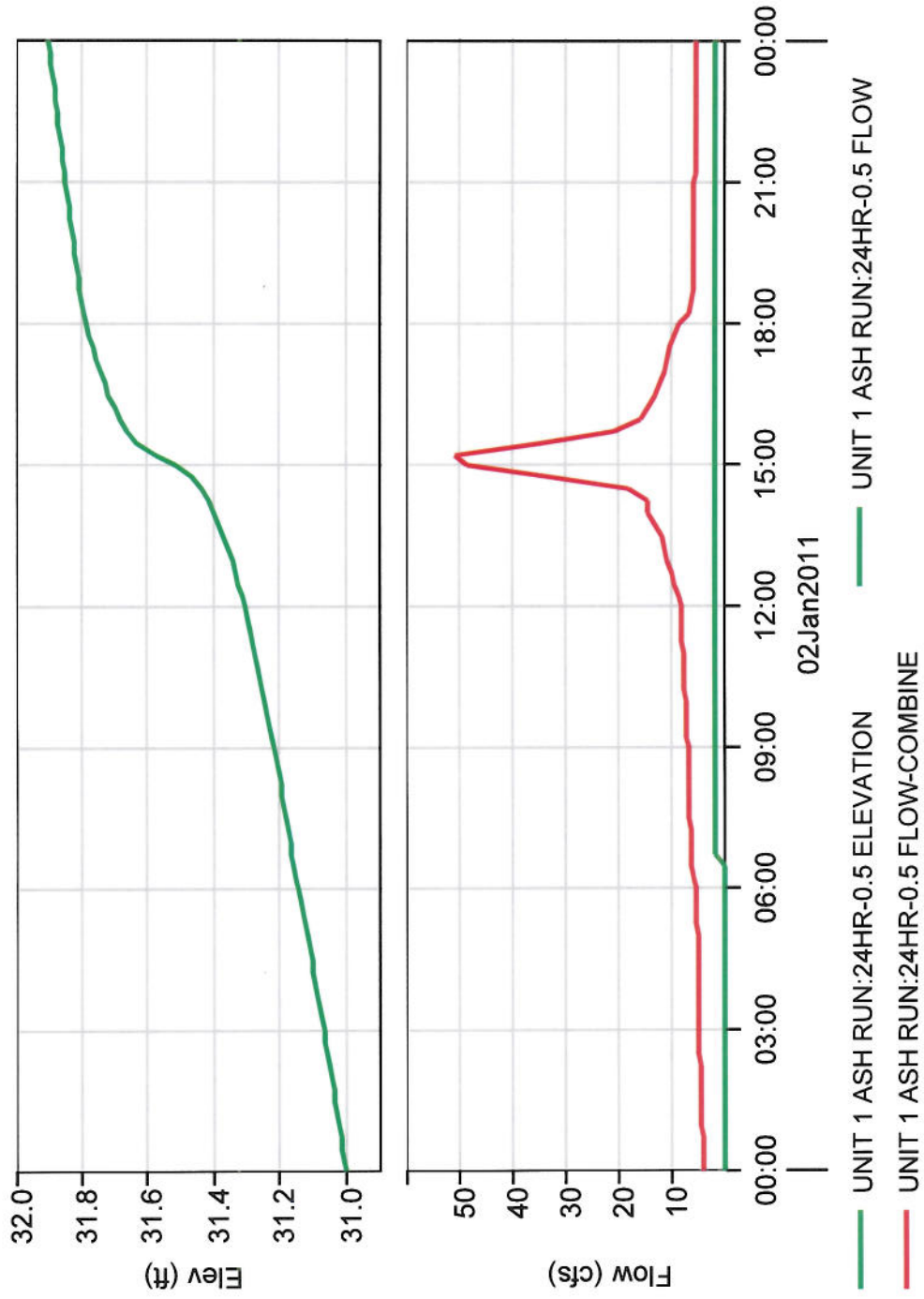


Scenario No. 2

24hr Rain Event-50% PMP

HEC-HMS Scenario Results

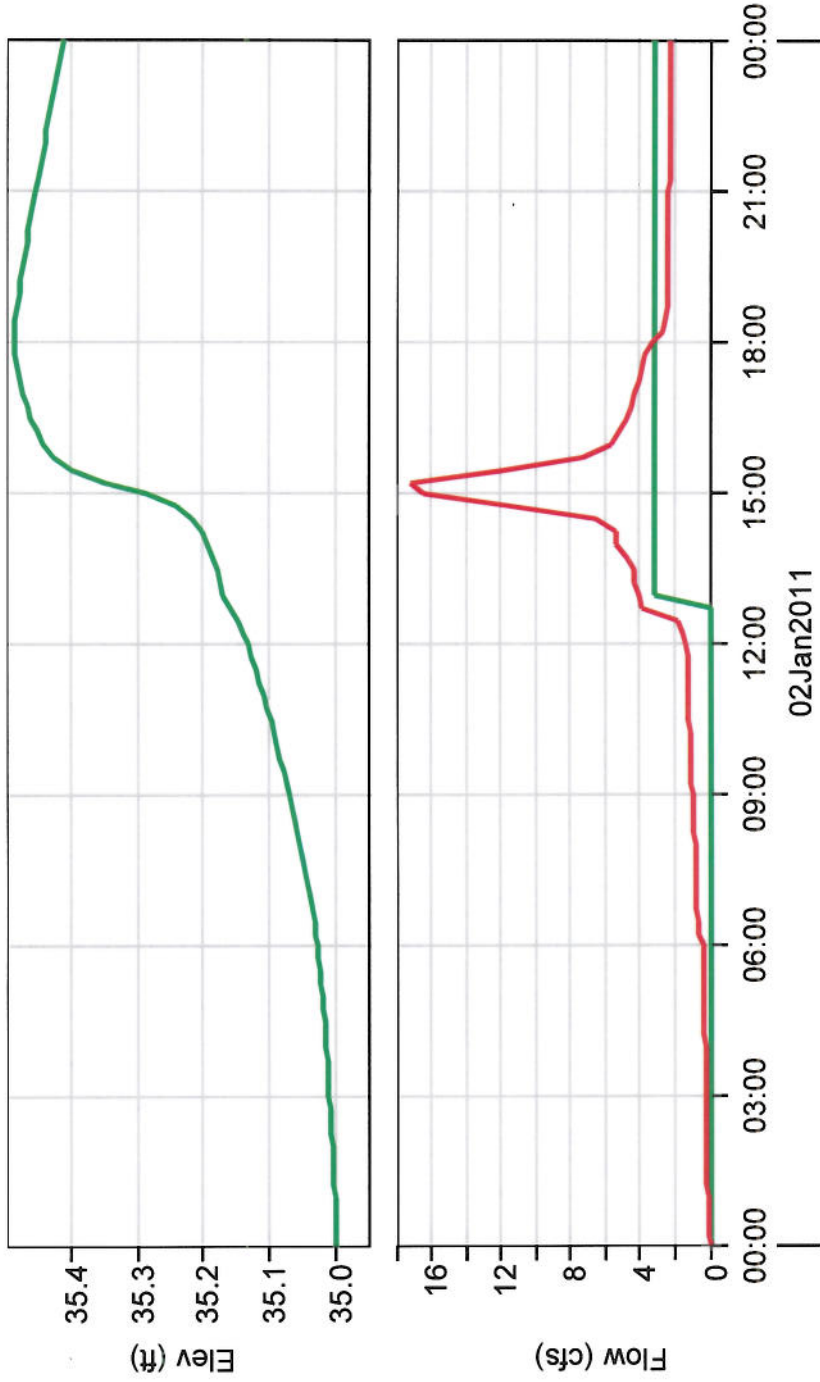
Scenario No.2
Unit 1 Ash Pond
24hr Event-50% PMP



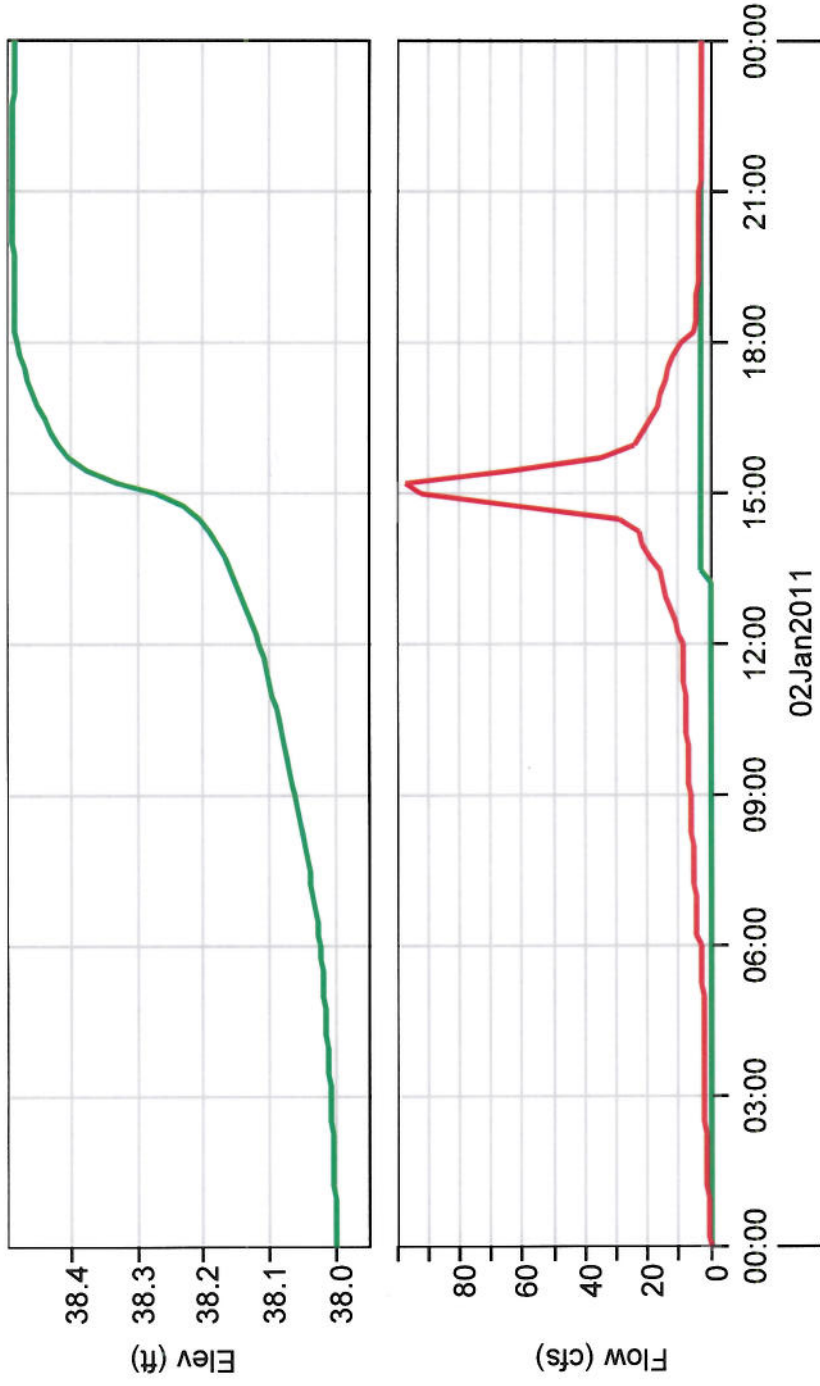
Scenario No.2
Unit 2/3 Ash Pond
24hr Event-50% PMP



Scenario No.2
Process Waste Pond
24hr Event-50% PMP



Scenario No.2
Scrubber Waste Pond
24hr Event-50% PMP



— SCRUBBER WASTE RUN:24HR-0.5 ELEVATION

— SCRUBBER WASTE RUN:24HR-0.5 FLOW

— SCRUBBER WASTE RUN:24HR-0.5 FLOW-COMBINE

Scenario No. 2

72hr Rain Event

HEC-HMS Scenario Results

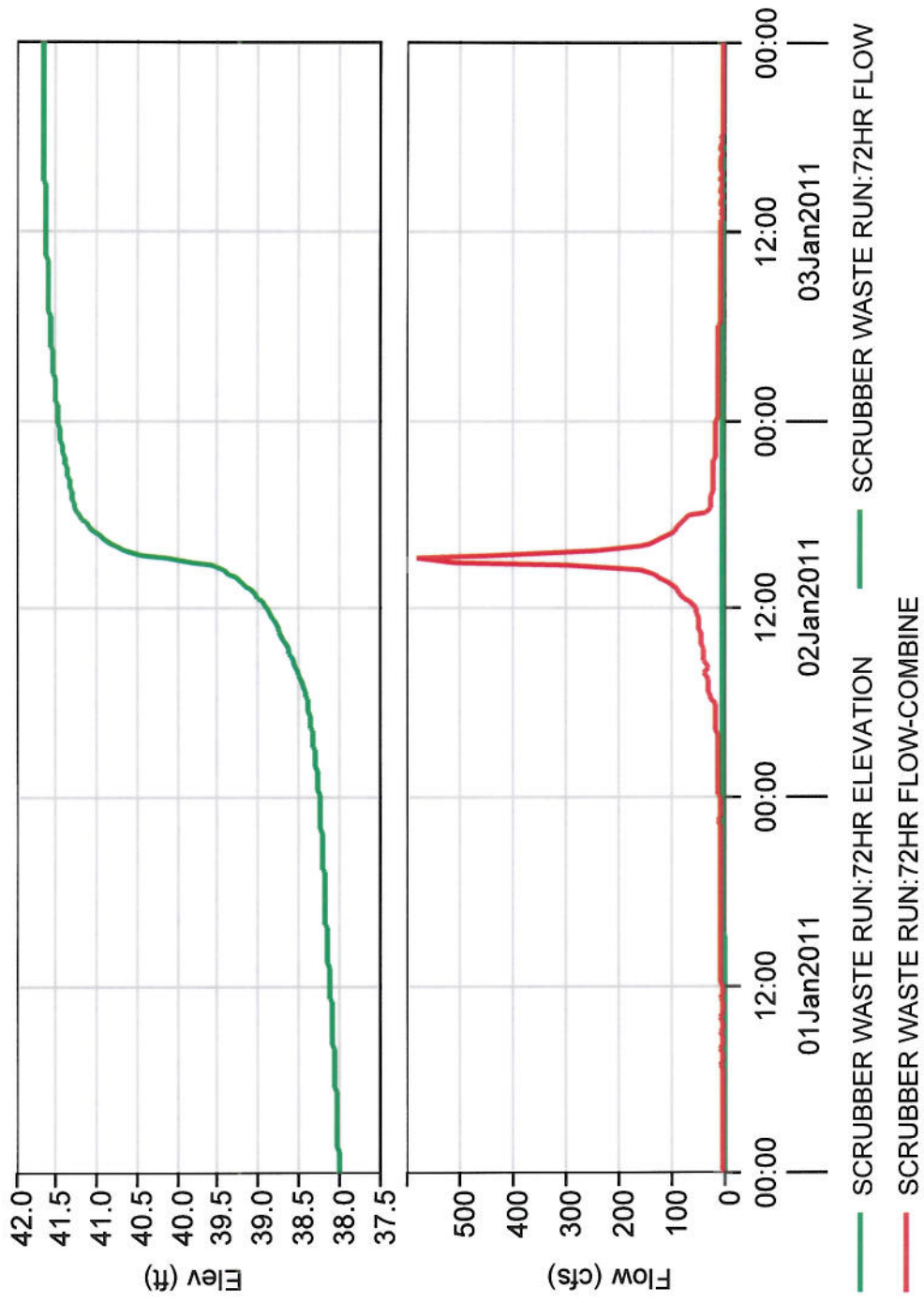
Scenario No.2
Unit 1 Ash Pond
72hr Event



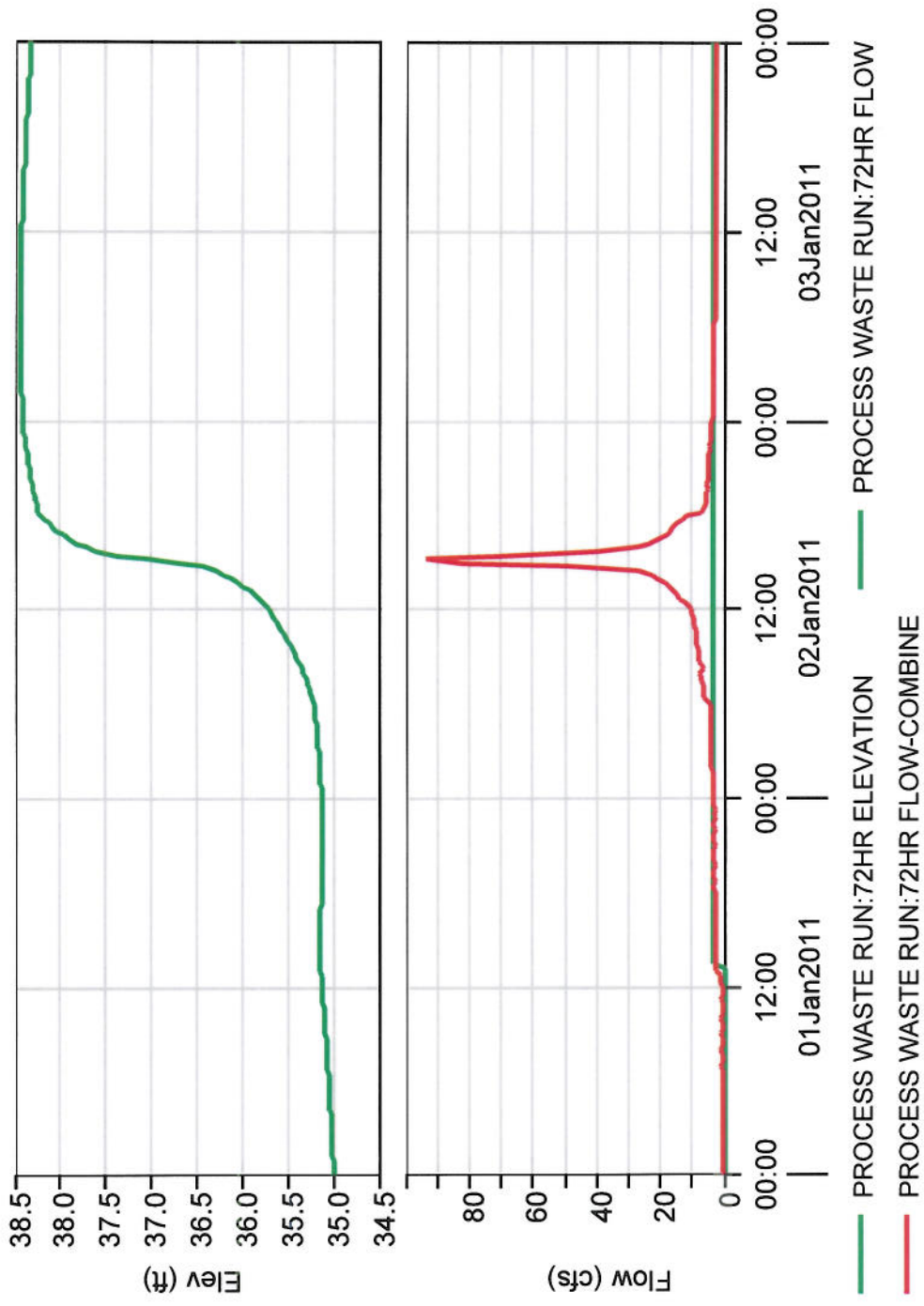
Scenario No.2
2/3 Ash Pond
72hr Event



Scenario No.2
Scrubber Waste Pond
72hr Event



Scenario No.2
Process Waste Pond
72hr Event



Scenario No. 2

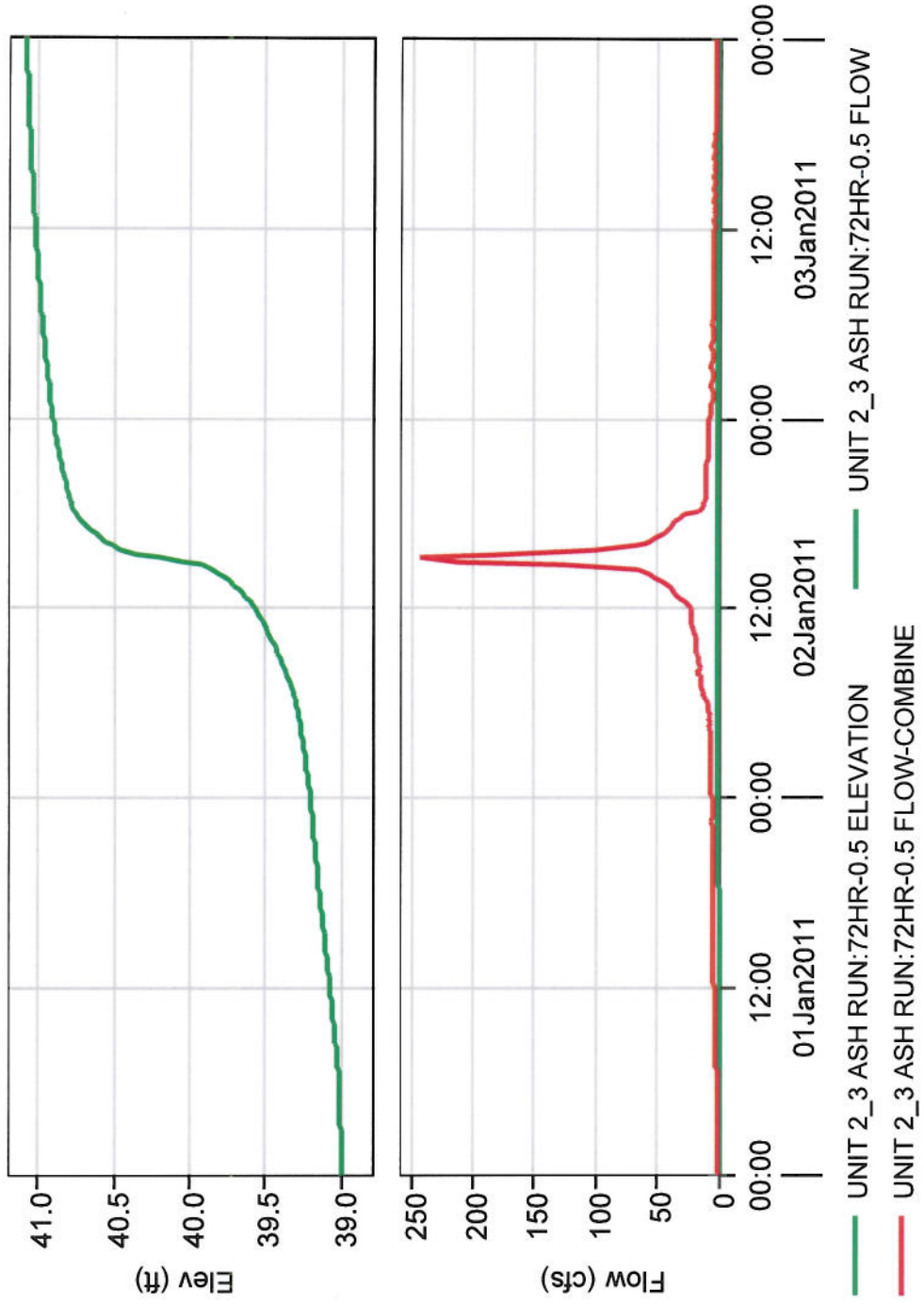
72hr Rain Event-50% PMP

HEC-HMS Scenario Results

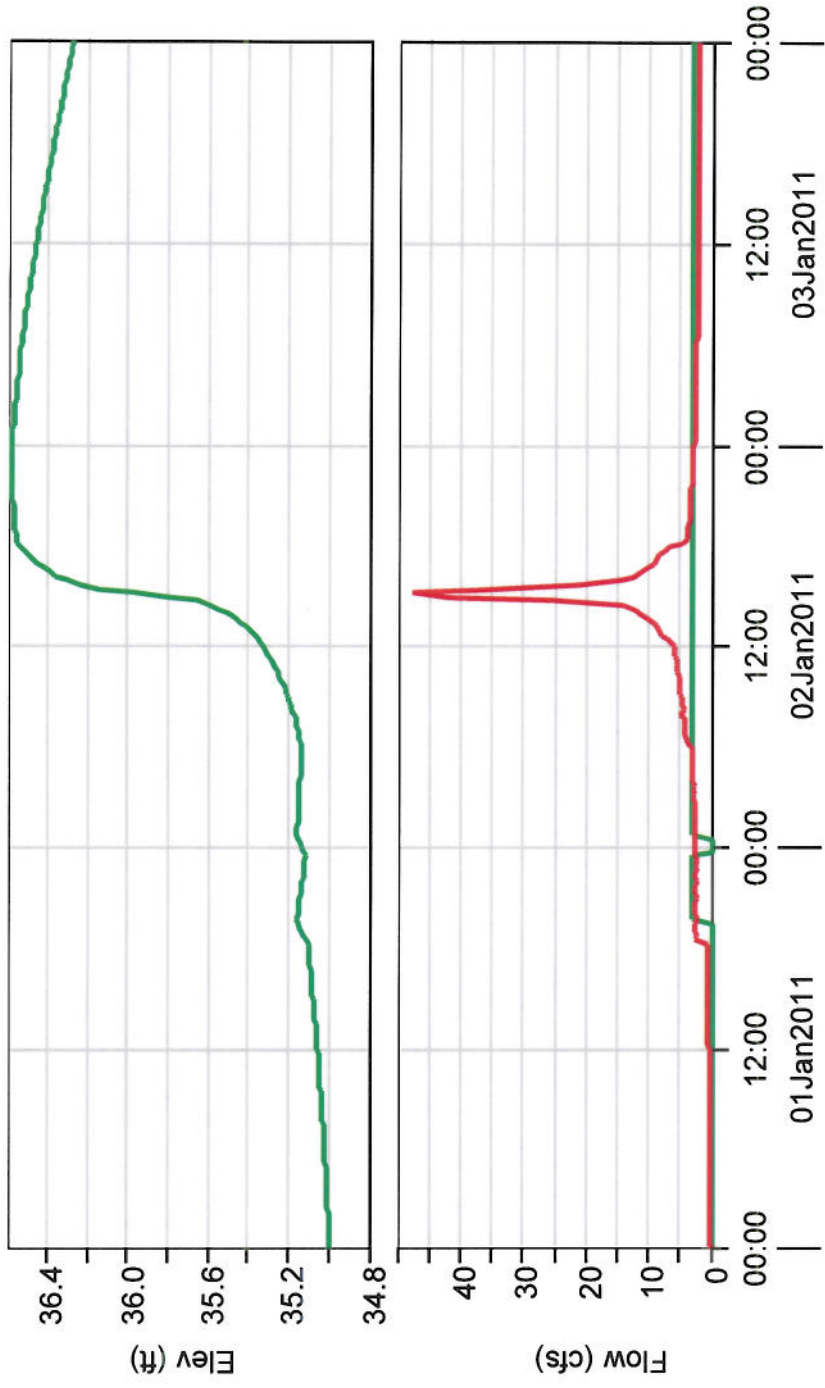
Scenario No.2
Unit 1 Ash Pond
72hr Event-50% PMP



Scenario No.2
Unit 2/3 Ash Pond
72hr Event-50% PMP



Scenario No.2
Process Waste Pond
72hr Event-50% PMP

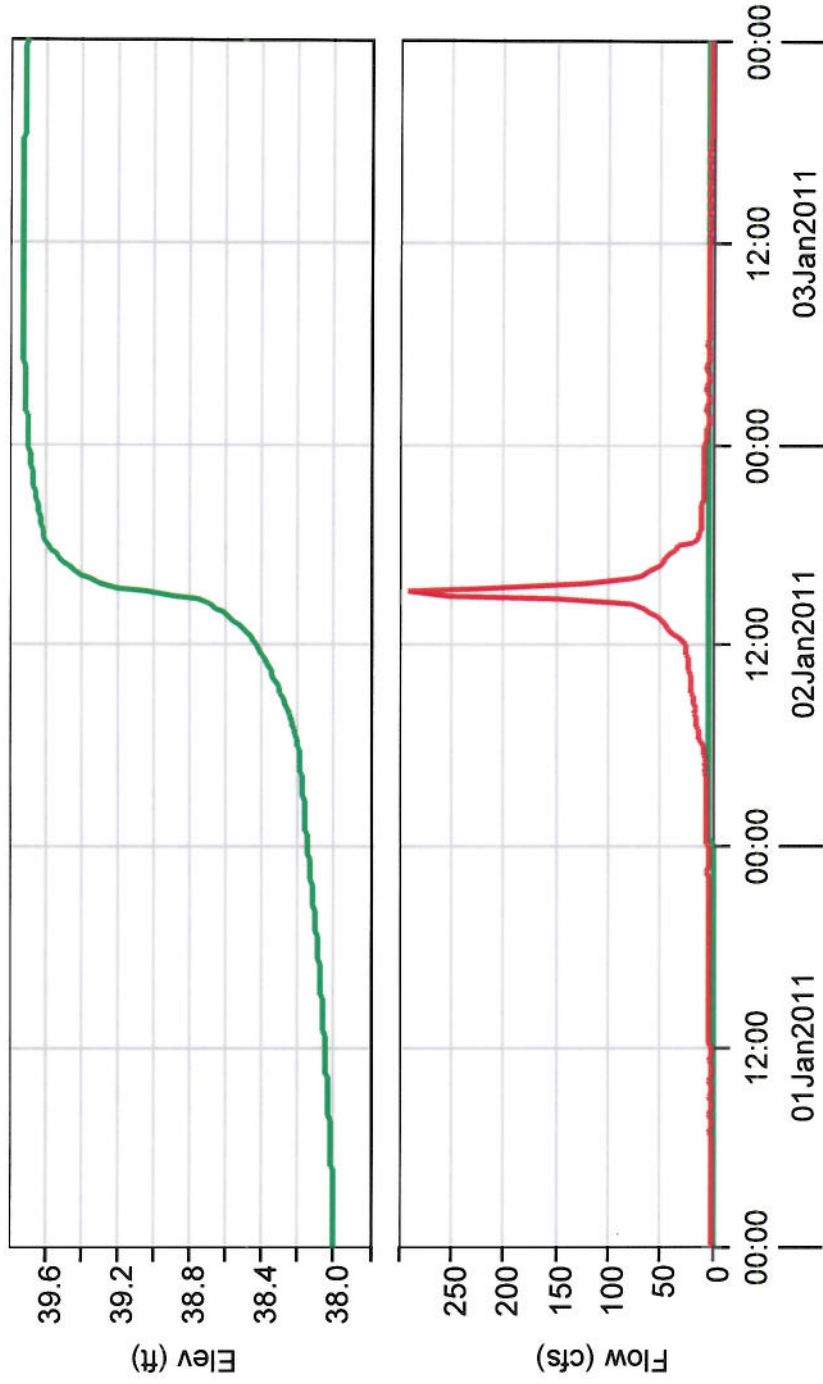


PROCESS WASTE RUN:72HR-0.5 ELEVATION

PROCESS WASTE RUN:72HR-0.5 FLOW

PROCESS WASTE RUN:72HR-0.5 FLOW-COMBINE

Scenario No.2
Scrubber Waste Pond
72hr Event-50% PMP



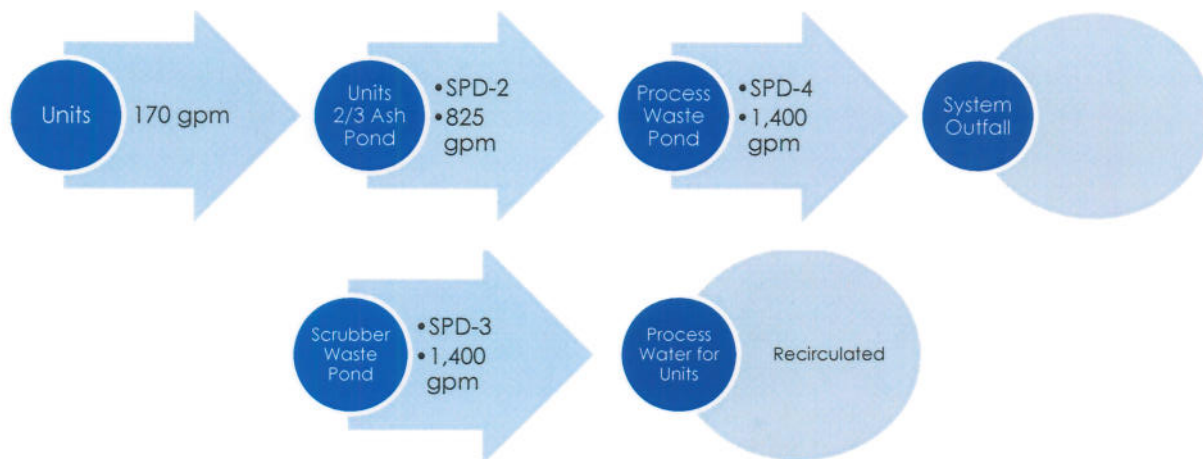
— SCRUBBER WASTE RUN:72HR-0.5 ELEVATION

— SCRUBBER WASTE RUN:72HR-0.5 FLOW

— SCRUBBER WASTE RUN:72HR-0.5 FLOW-COMBINE

Scenario No. 3

HEC-HMS Scenario Results

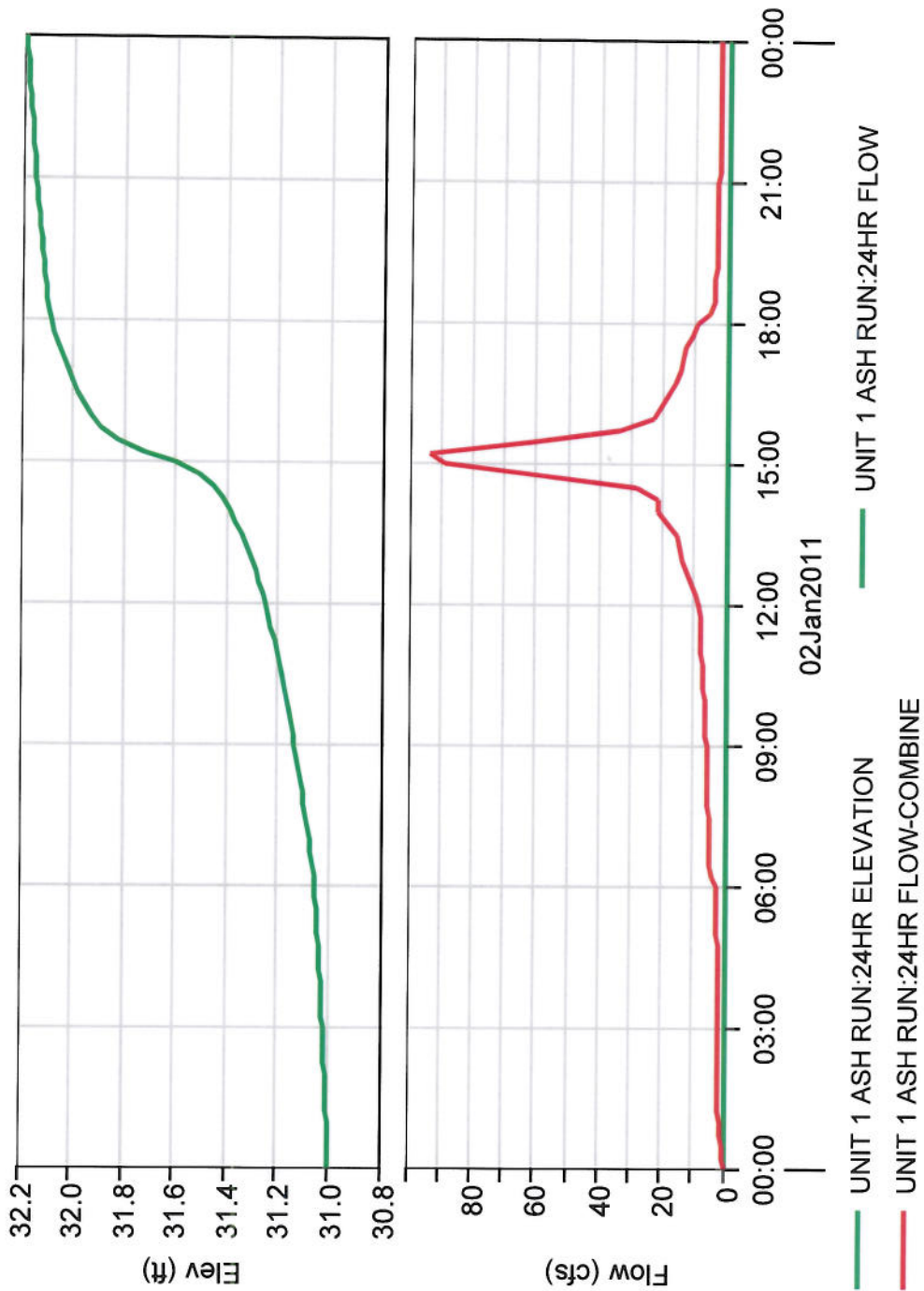


Scenario No. 3

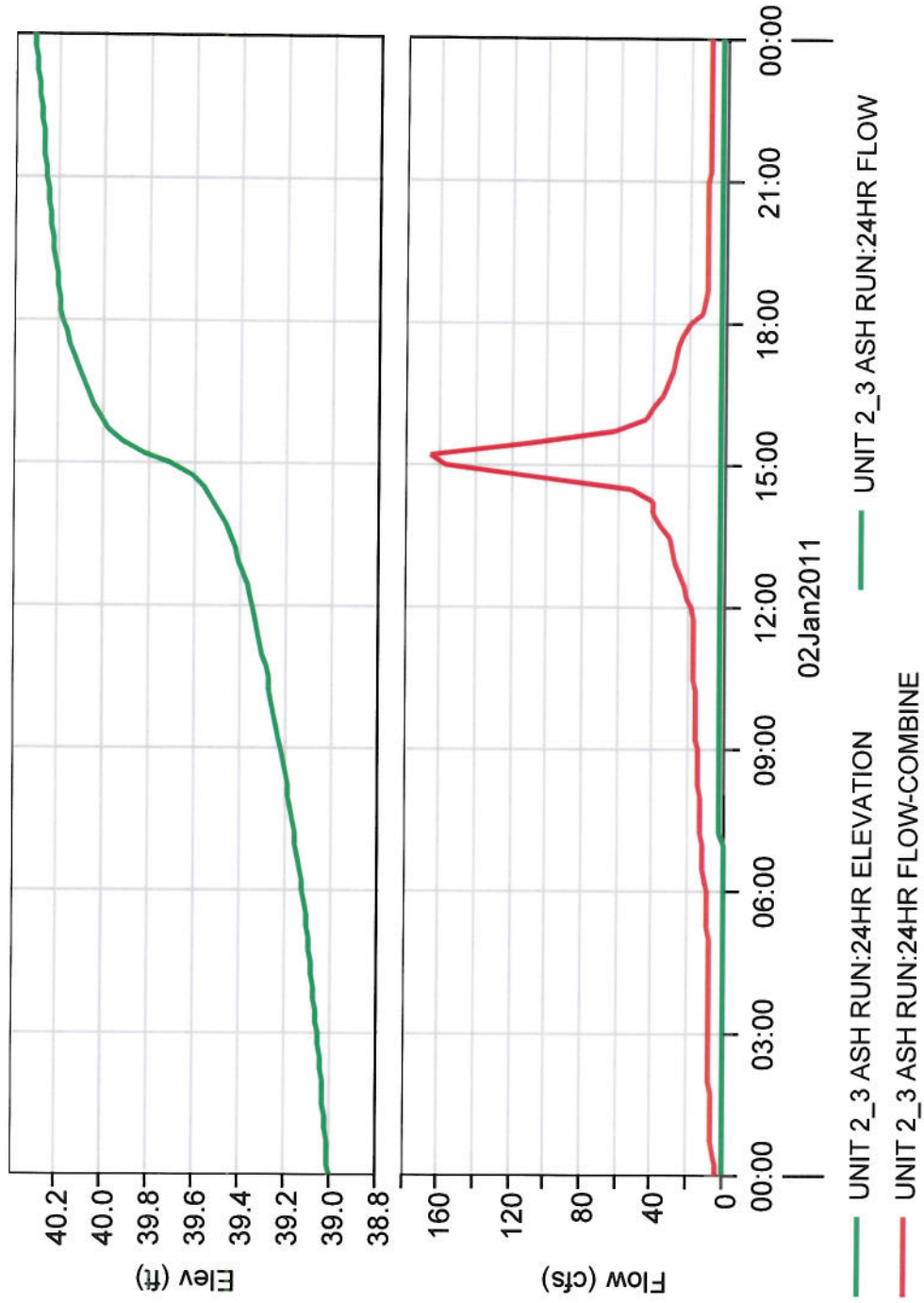
24hr Rain Event

HEC-HMS Scenario Results

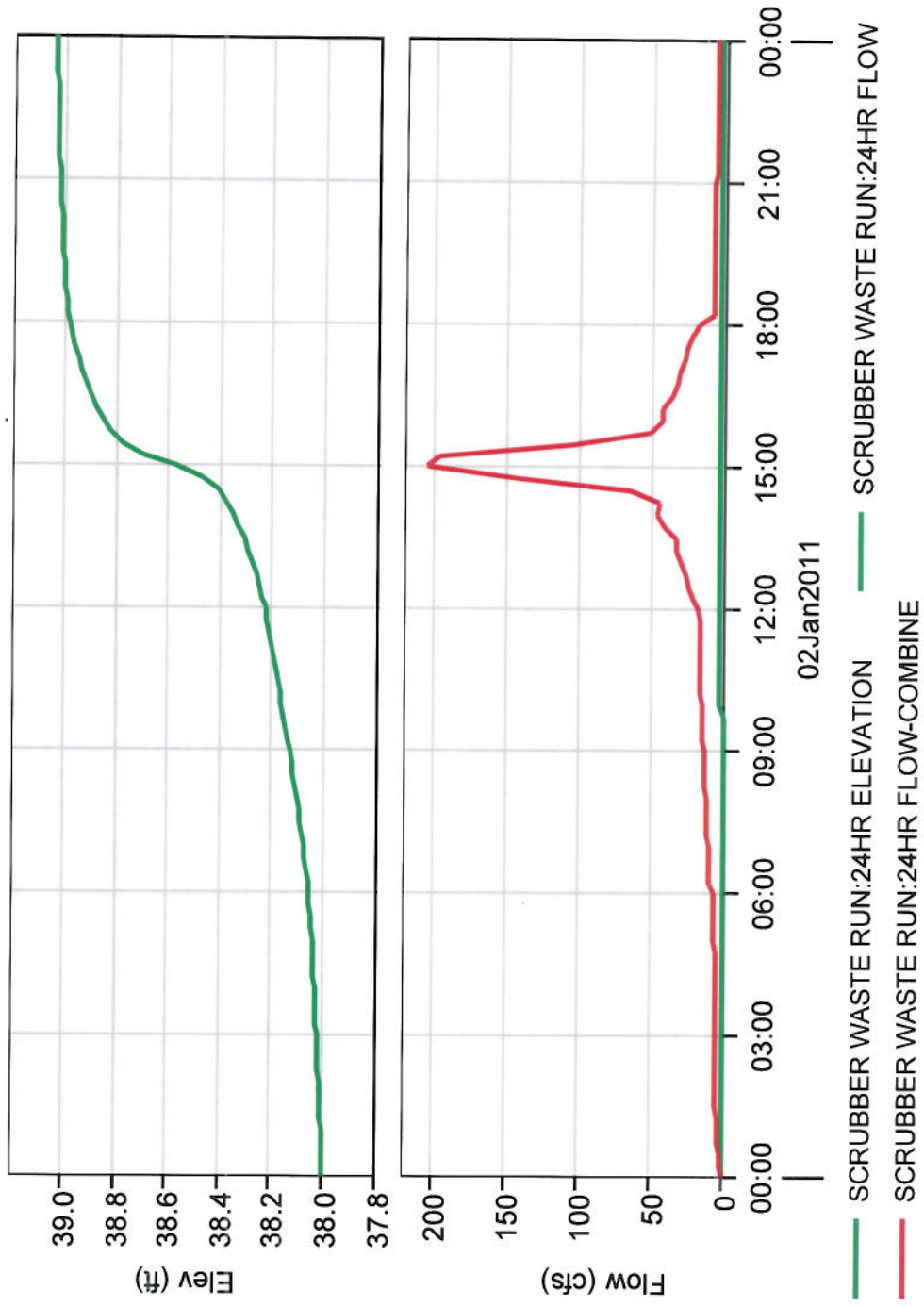
Scenario No.3
Unit 1 Ash Pond
24hr Event



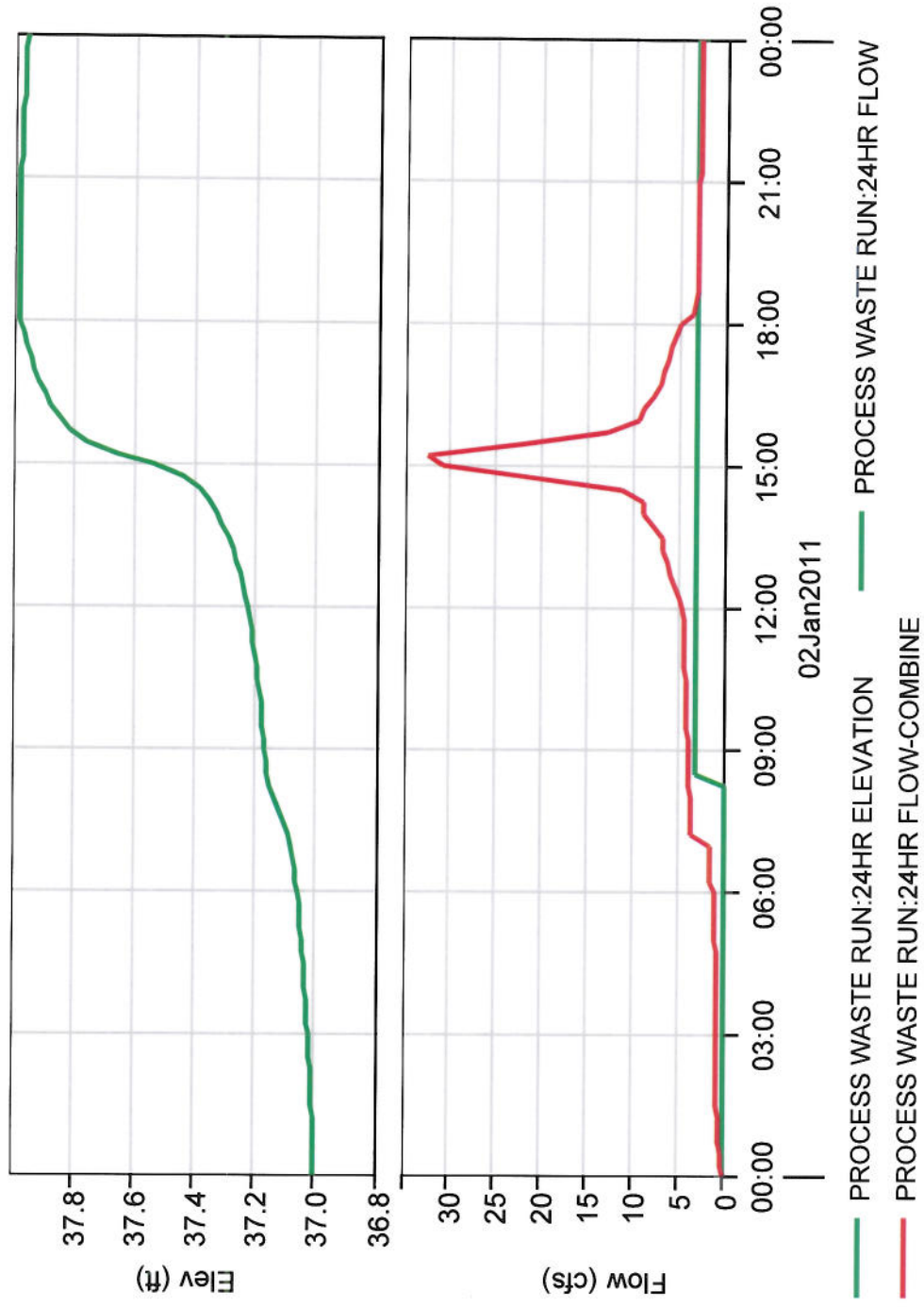
Scenario No.3
2/3 Ash Pond
24hr Event



Scenario No.3
Scrubber Waste Pond
24hr Event



Scenario No.3
Process Waste Pond
24hr Event

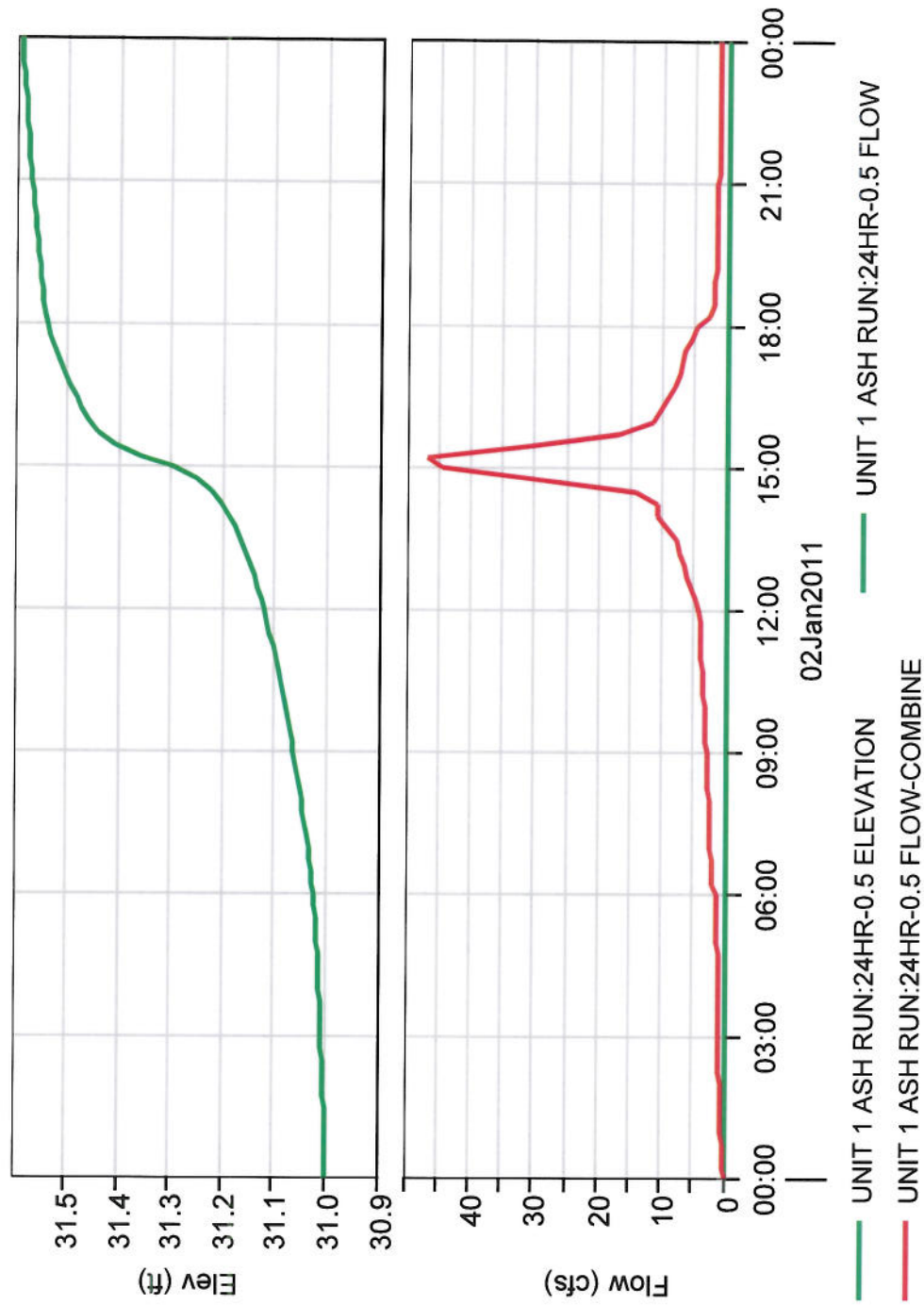


Scenario No. 3

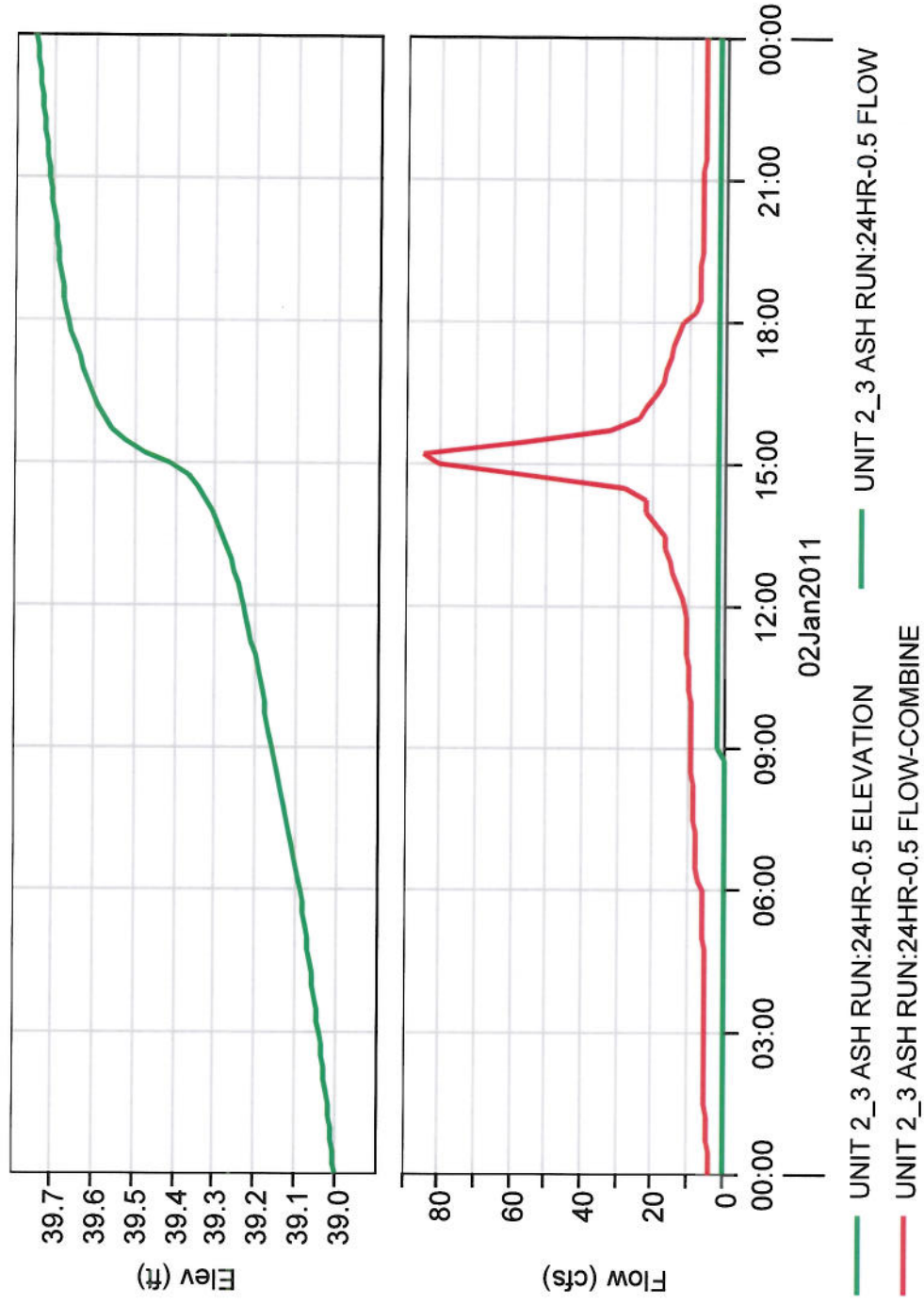
24hr Rain Event-50% PMP

HEC-HMS Scenario Results

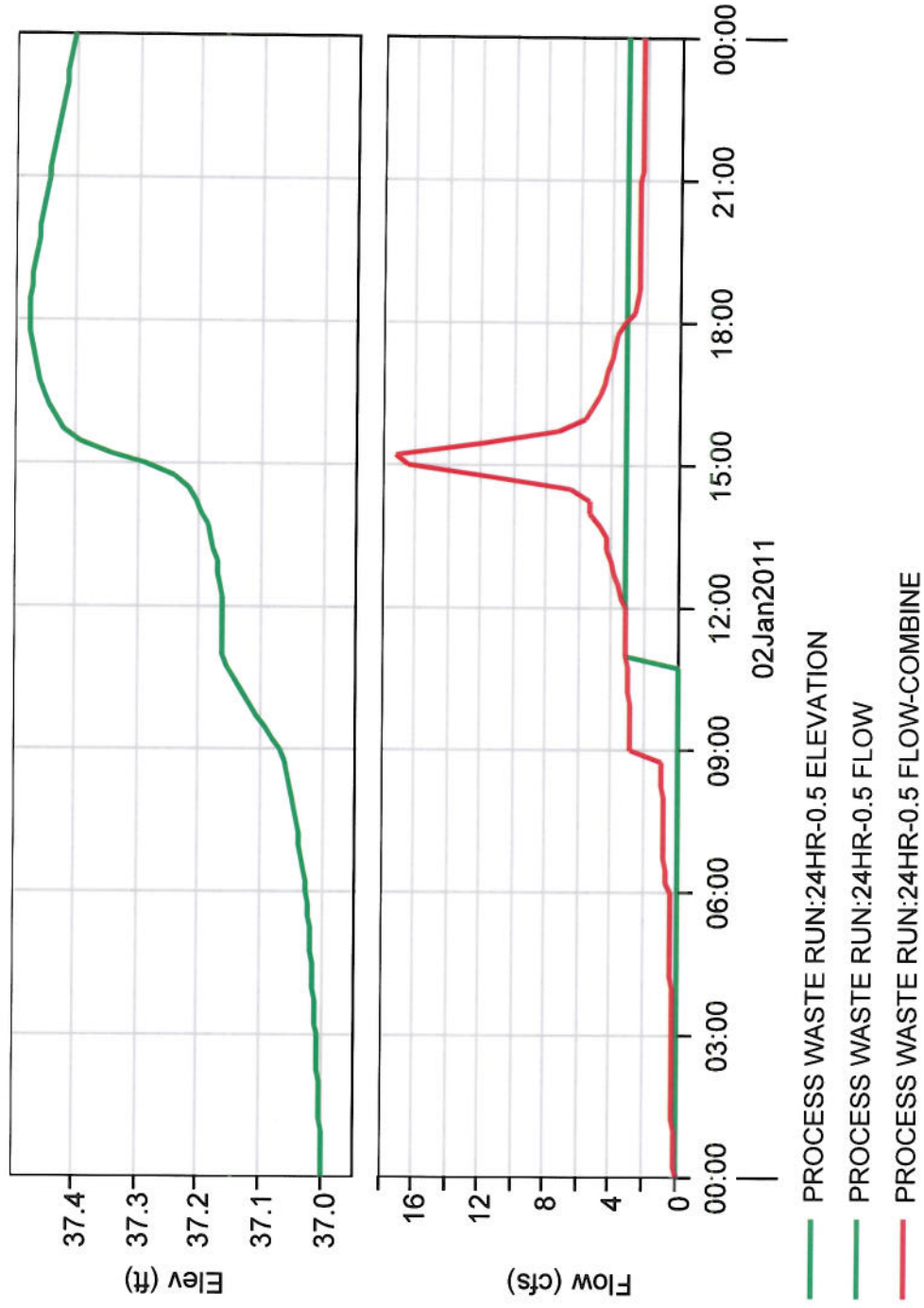
Scenario No.3
Unit 1 Ash Pond
24hr Event-50% PMP



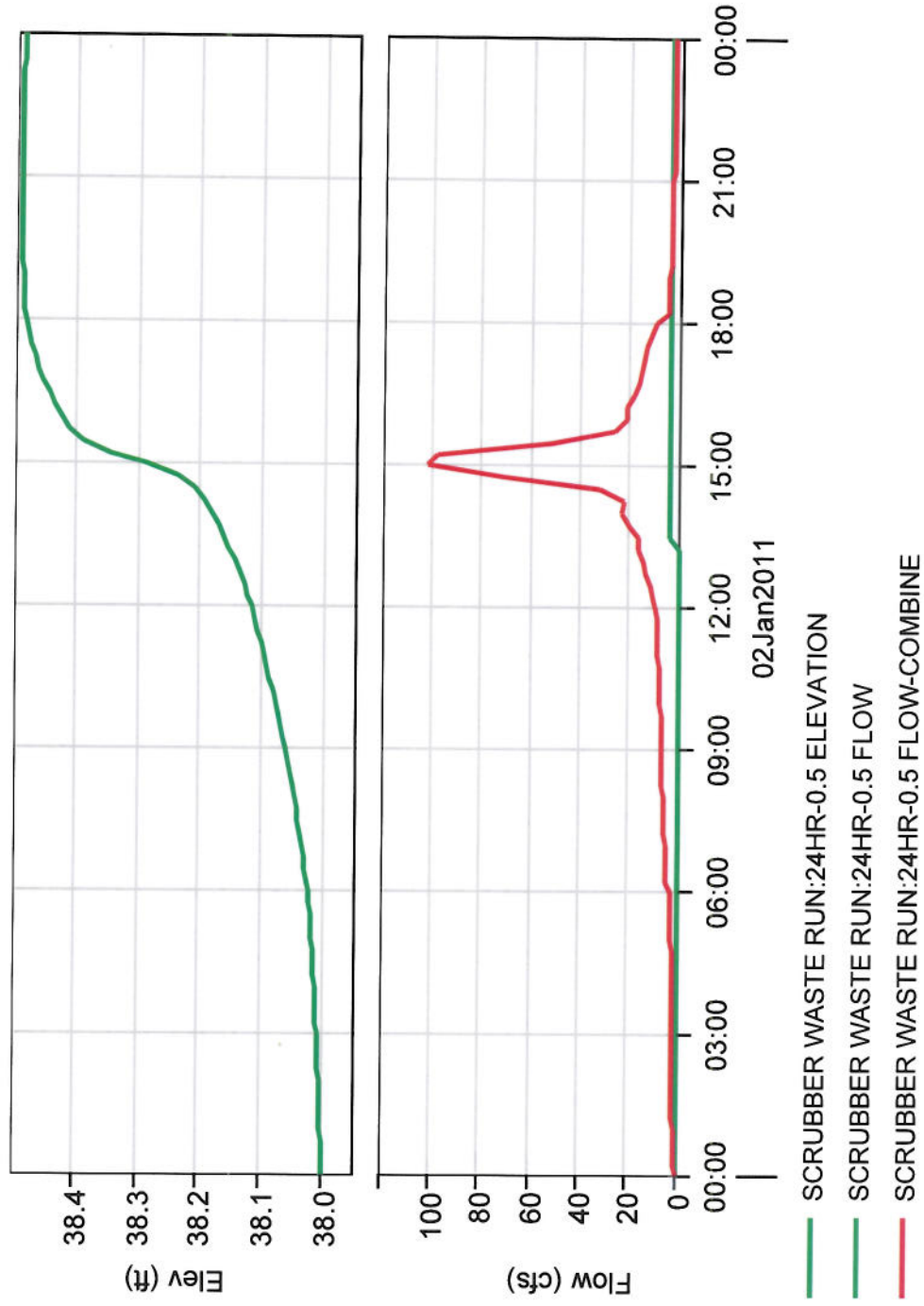
Scenario No.3
Unit 2/3 Ash Pond
24hr Event-50% PMP



Scenario No.3
Process Waste Pond
24hr Event-50% PMP



Scenario No.3
Scrubber Waste Pond
24hr Event-50% PMP

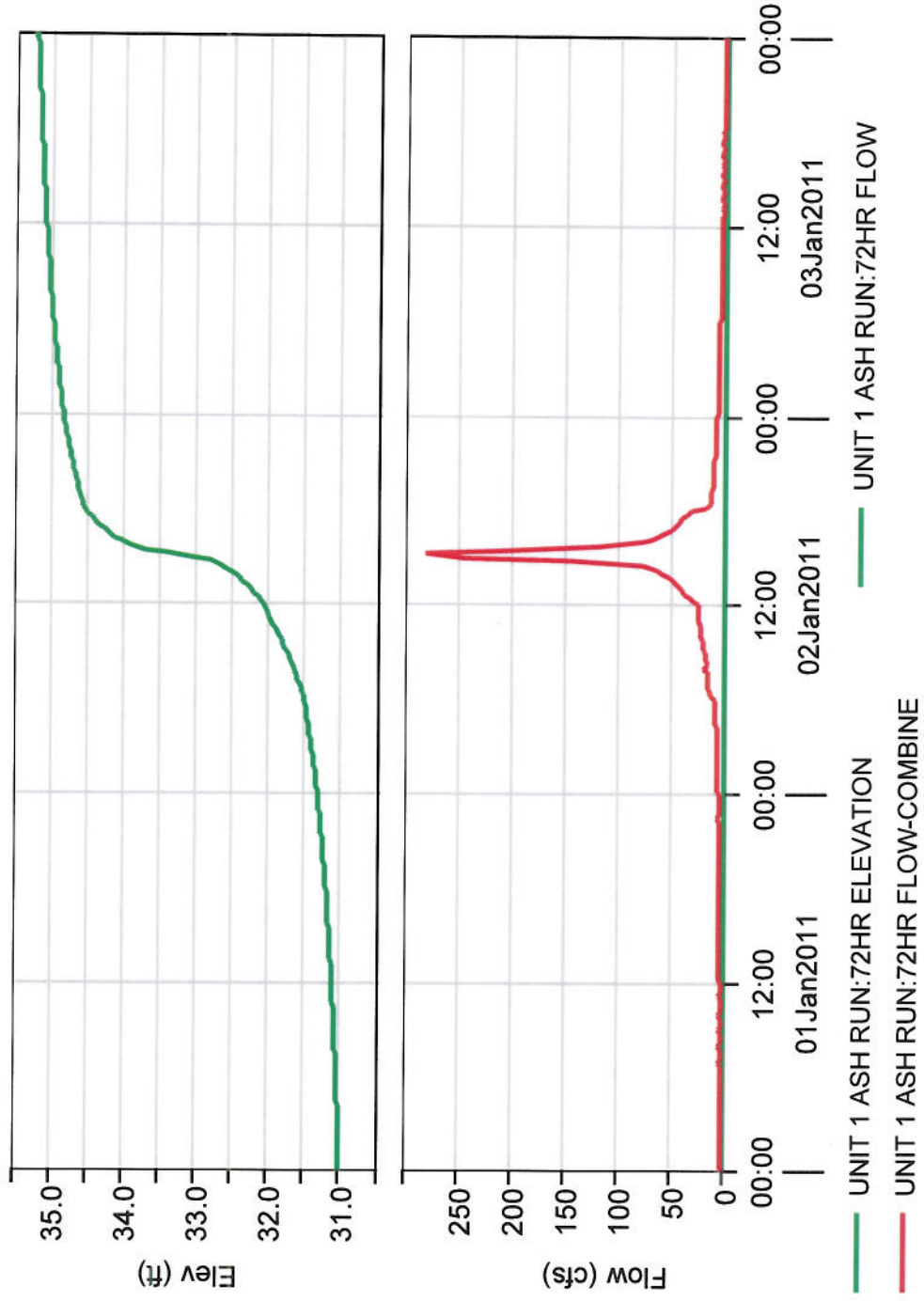


Scenario No. 3

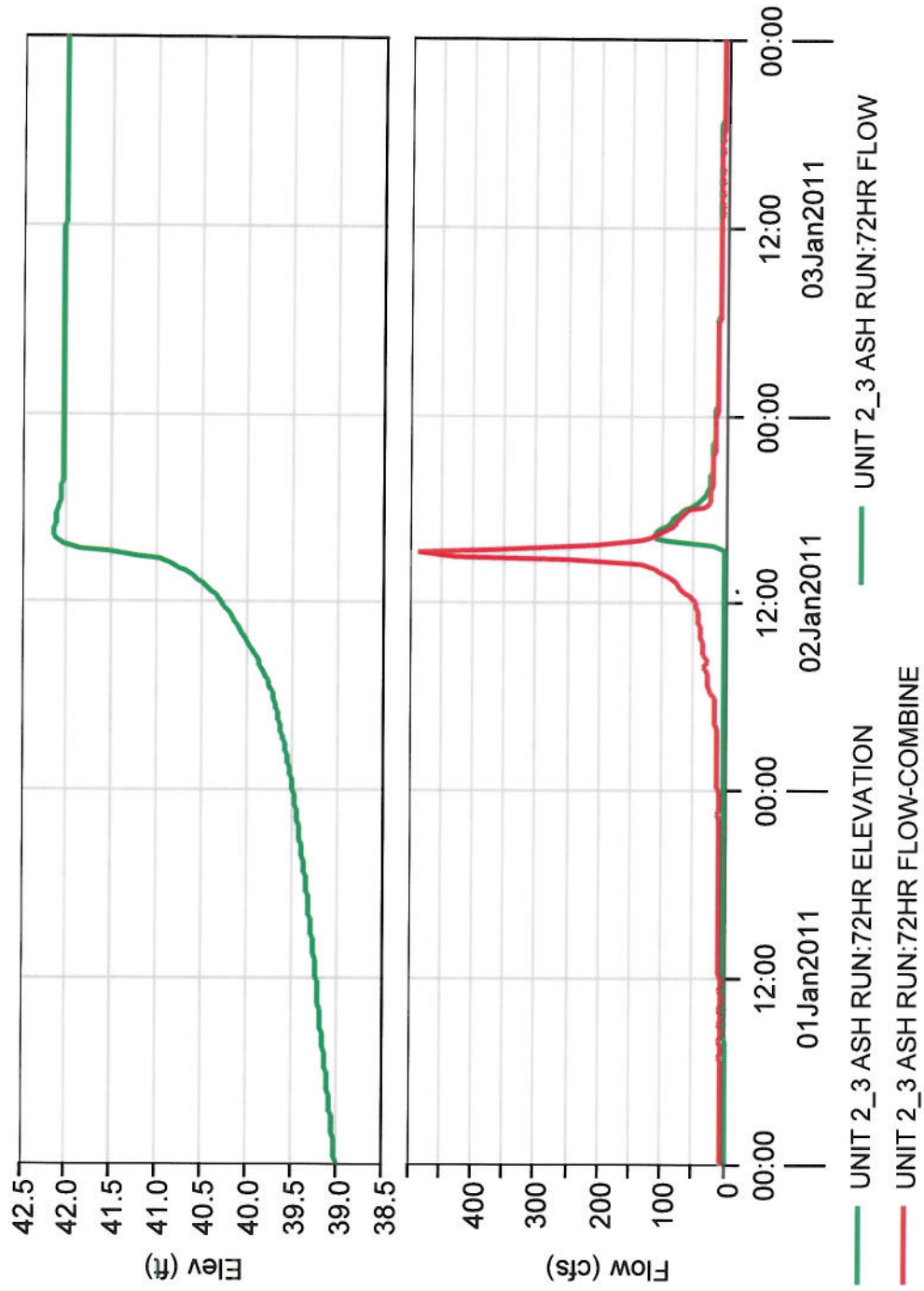
72hr Rain Event

HEC-HMS Scenario Results

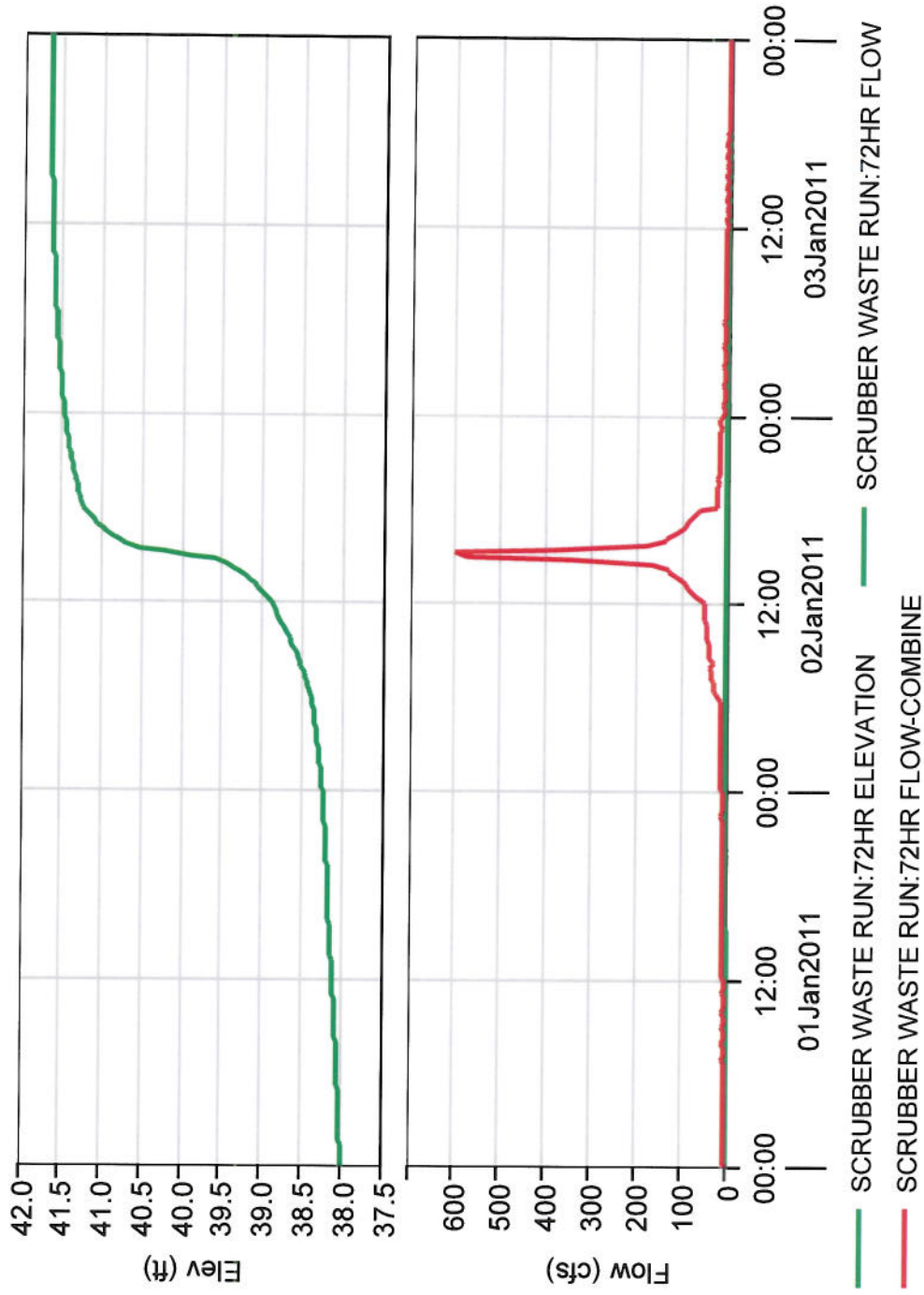
Scenario No.3
Unit 1 Ash Pond
72hr Event



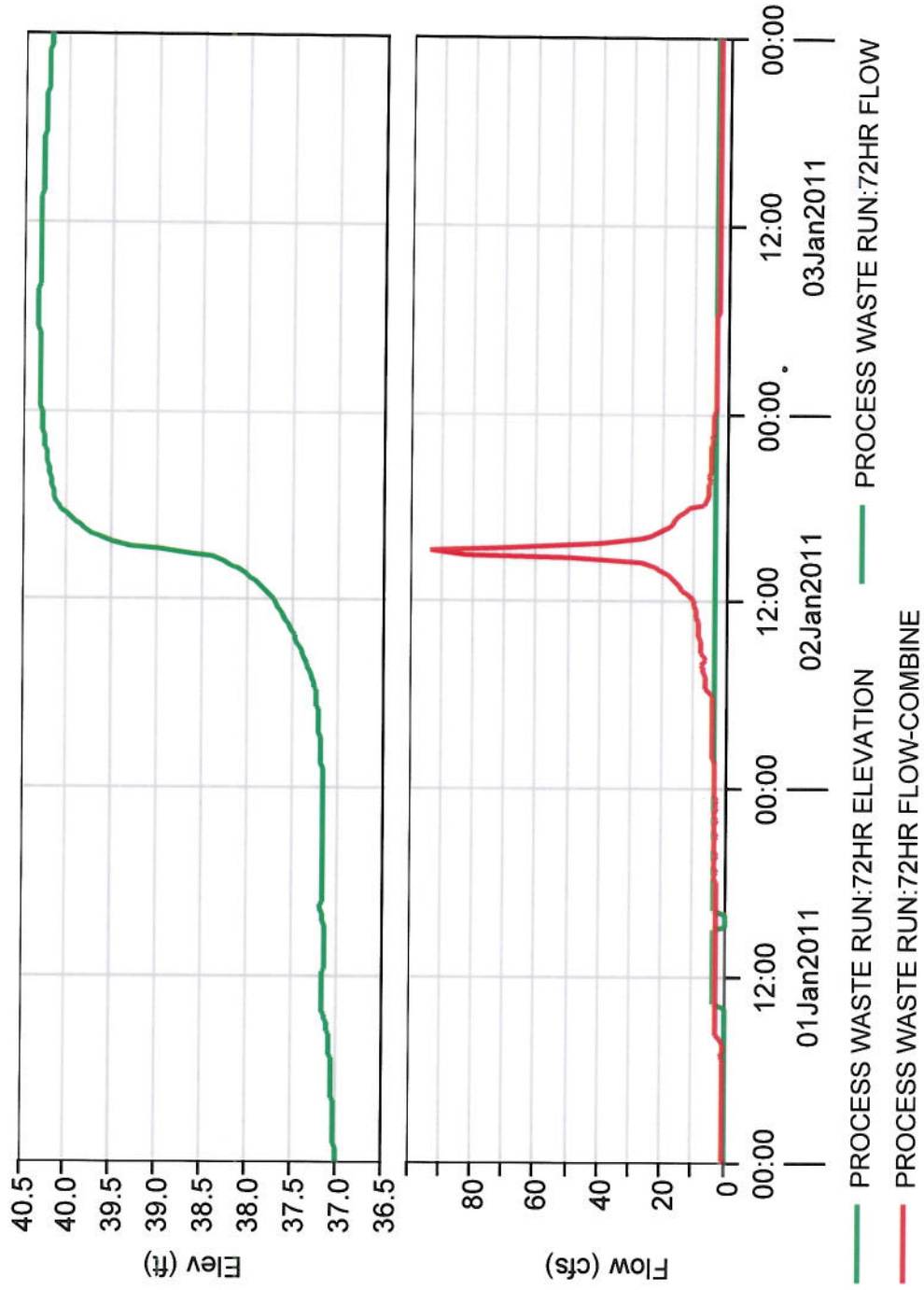
Scenario No.3
2/3 Ash Pond
72hr Event



Scenario No.3
Scrubber Waste Pond
72hr Event



Scenario No.3
Process Waste Pond
72hr Event

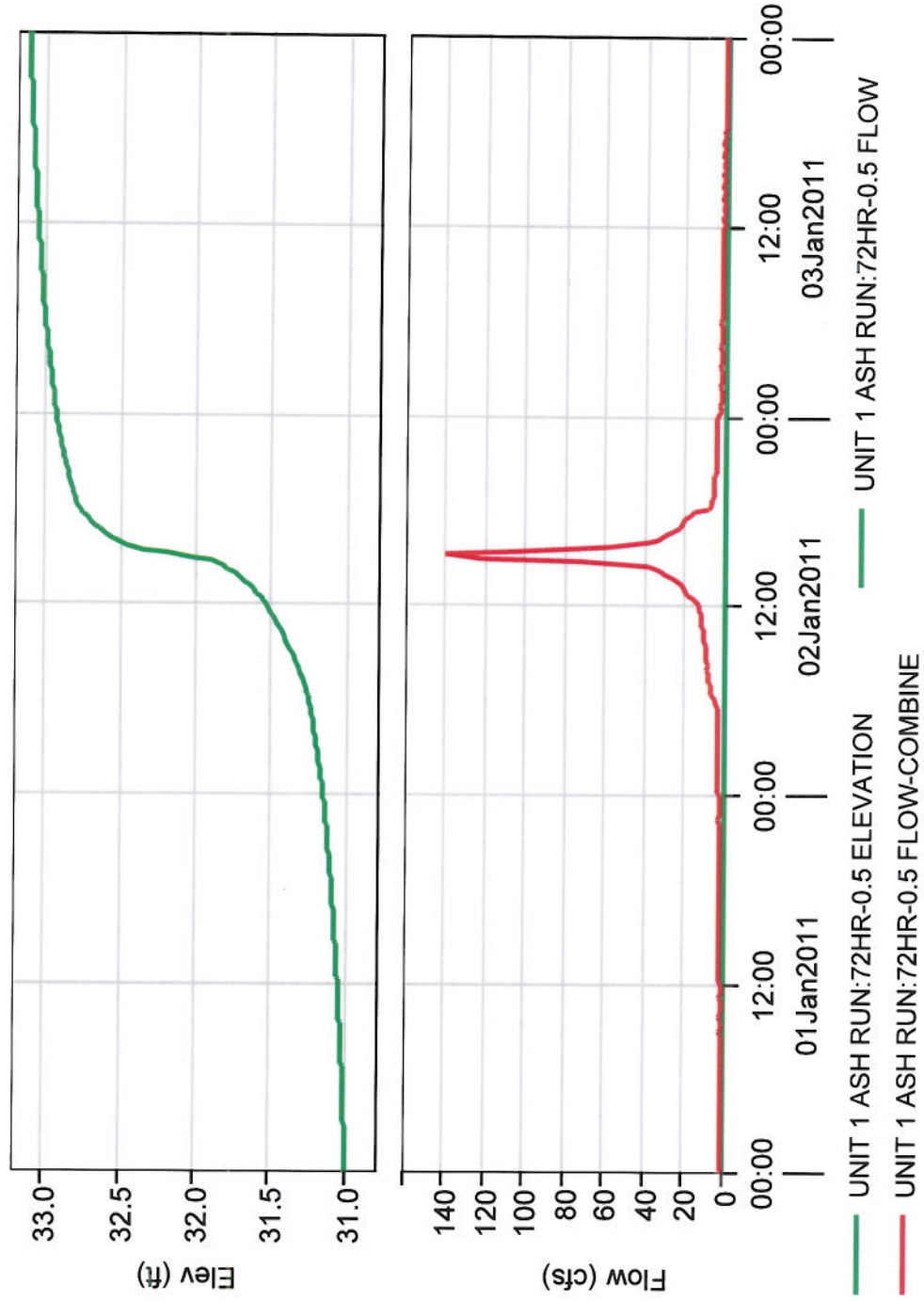


Scenario No. 3

72hr Rain Event-50% PMP

HEC-HMS Scenario Results

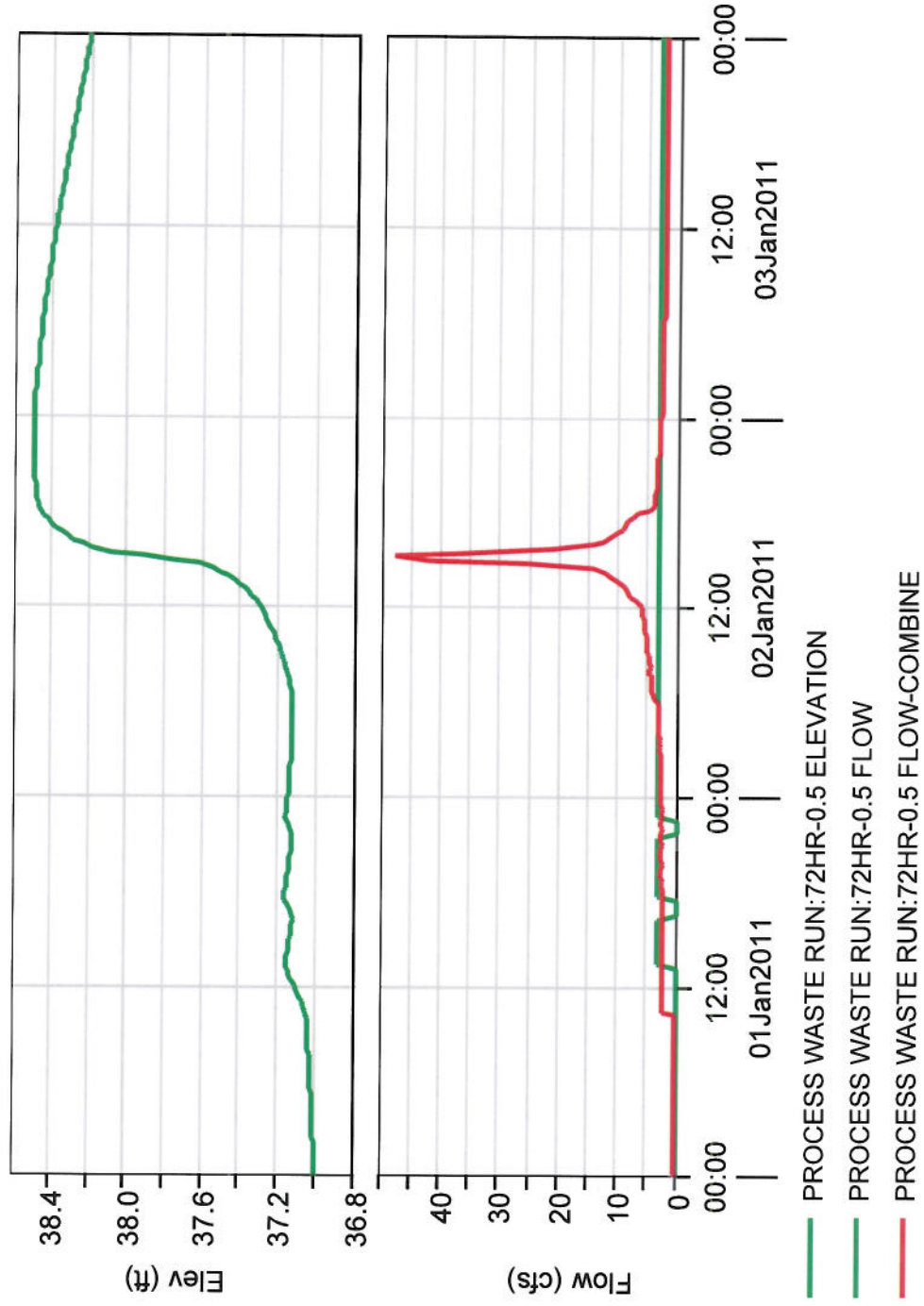
Scenario No.3
Unit 1 Ash Pond
72hr Event-50% PMP



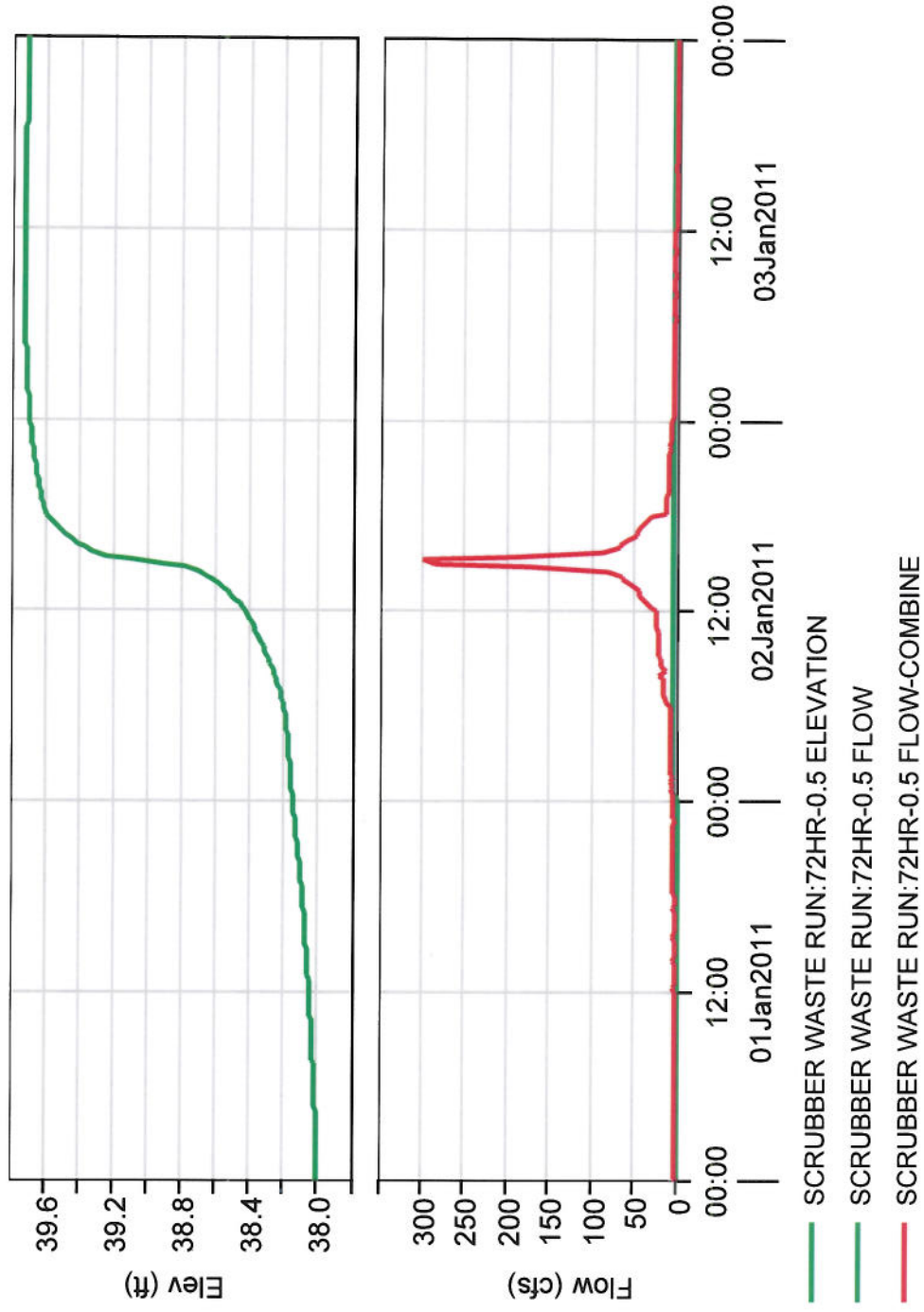
Scenario No.3
Unit 2/3 Ash Pond
72hr Event-50% PMP



Scenario No.3
Process Waste Pond
72hr Event-50% PMP

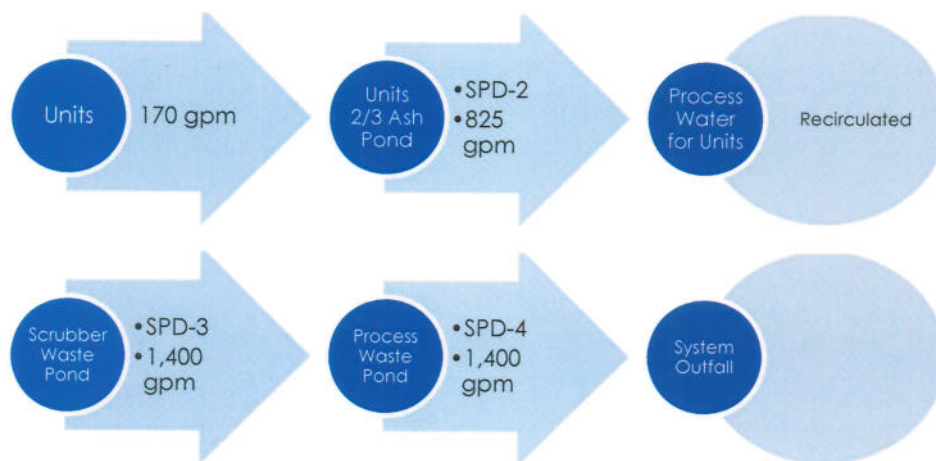


Scenario No.3
Scrubber Waste Pond
72hr Event-50% PMP



Scenario No. 4

HEC-HMS Scenario Results

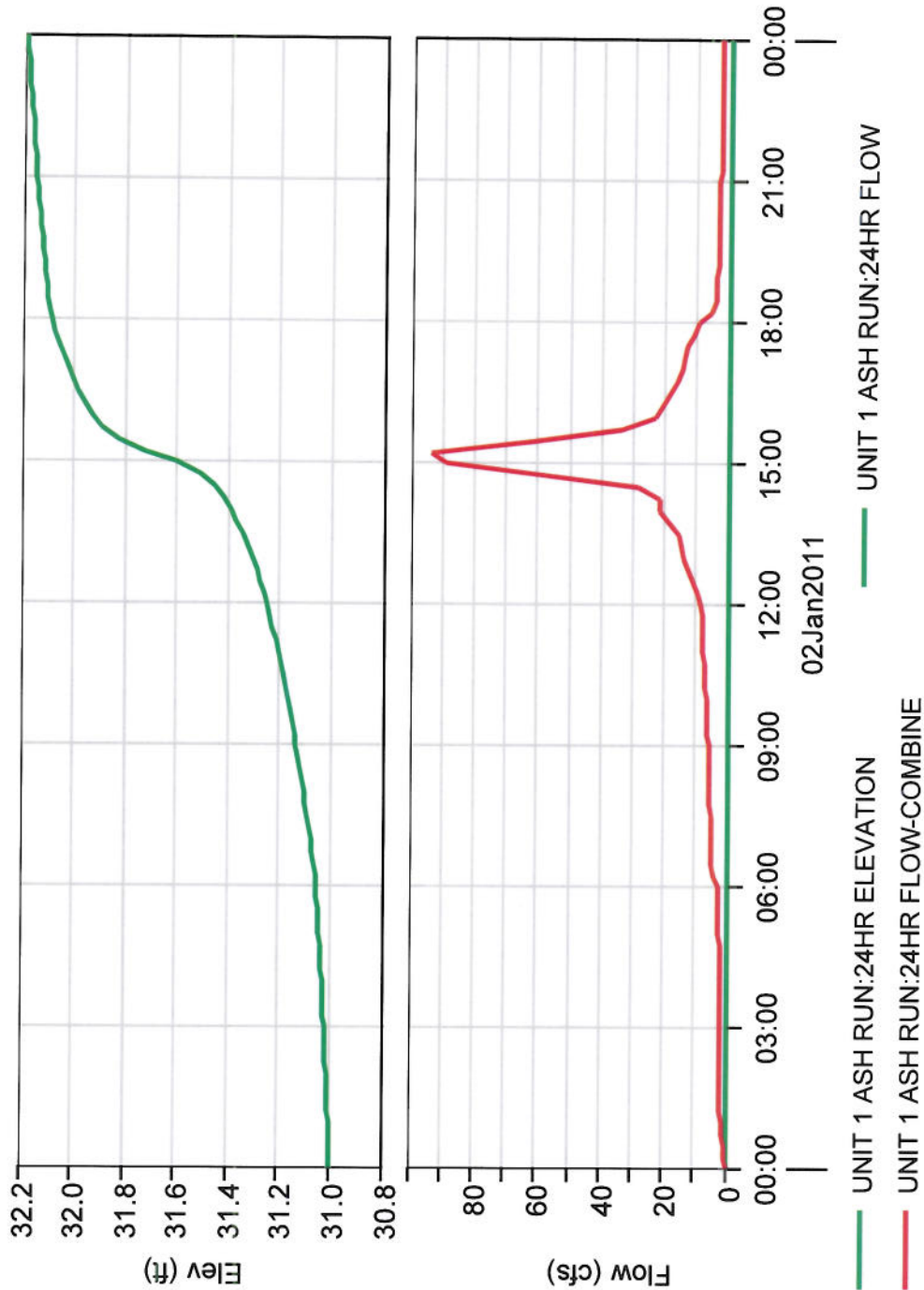


Scenario No. 4

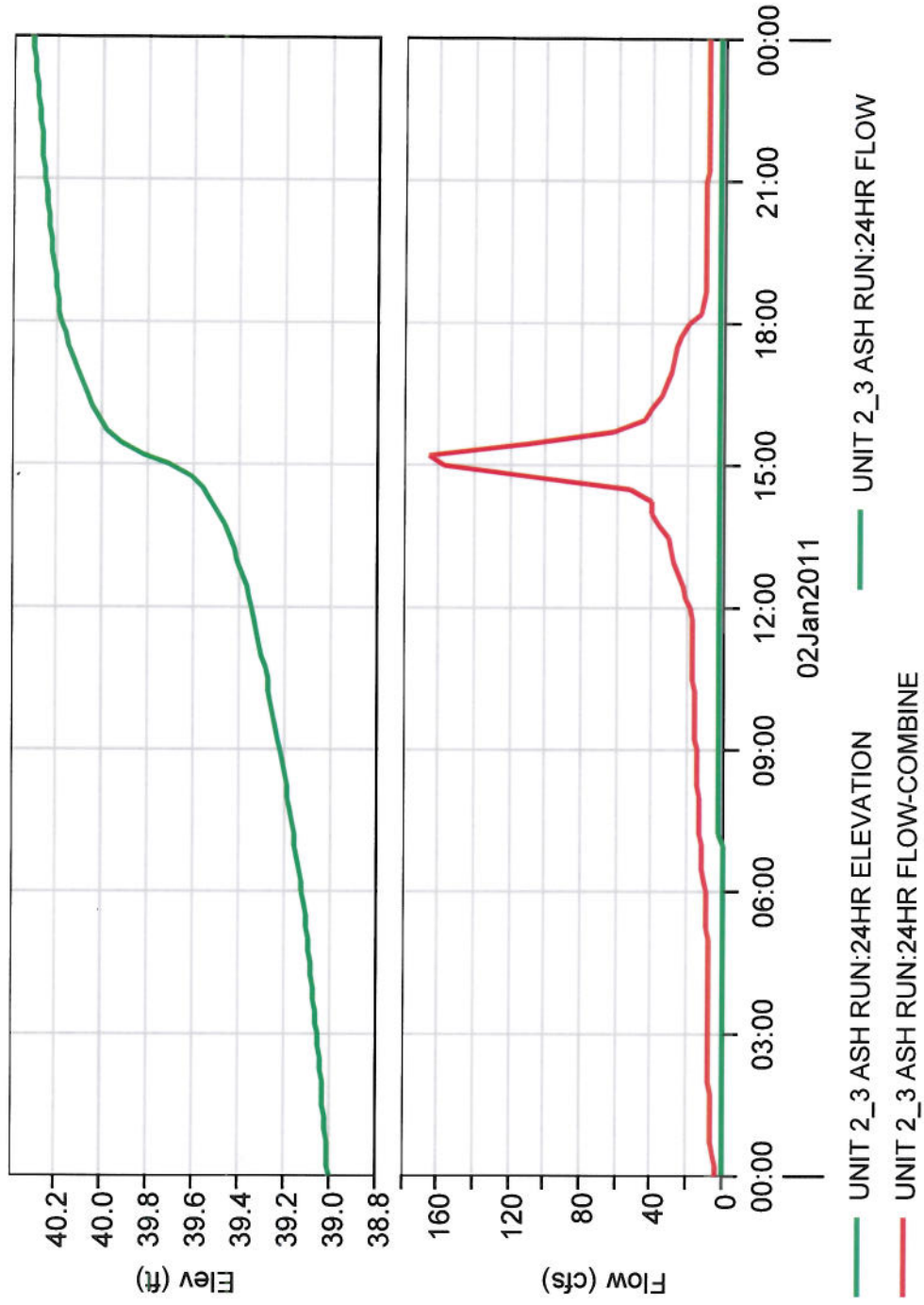
24hr Rain Event

HEC-HMS Scenario Results

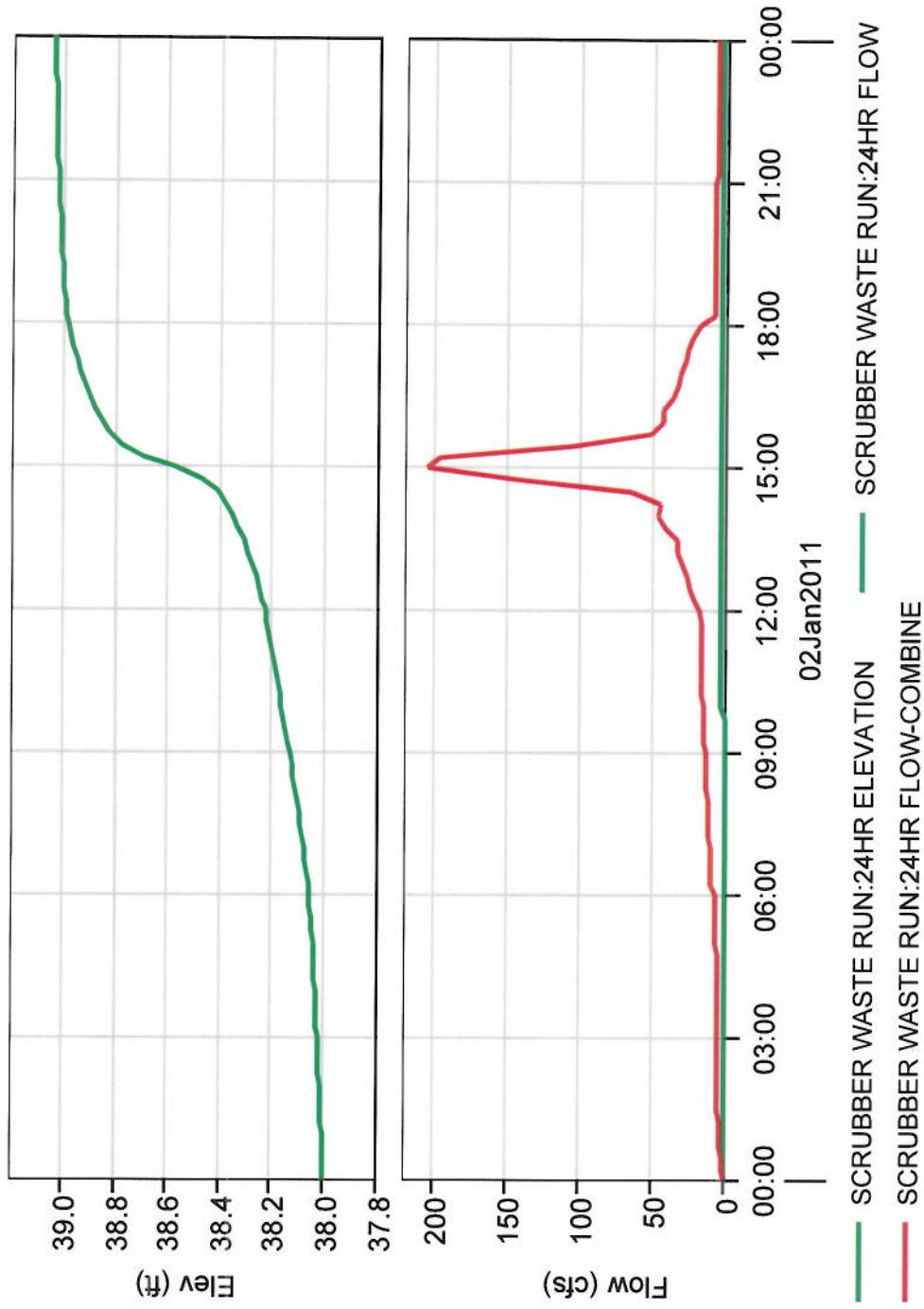
Scenario No.4
Unit 1 Ash Pond
24hr Event



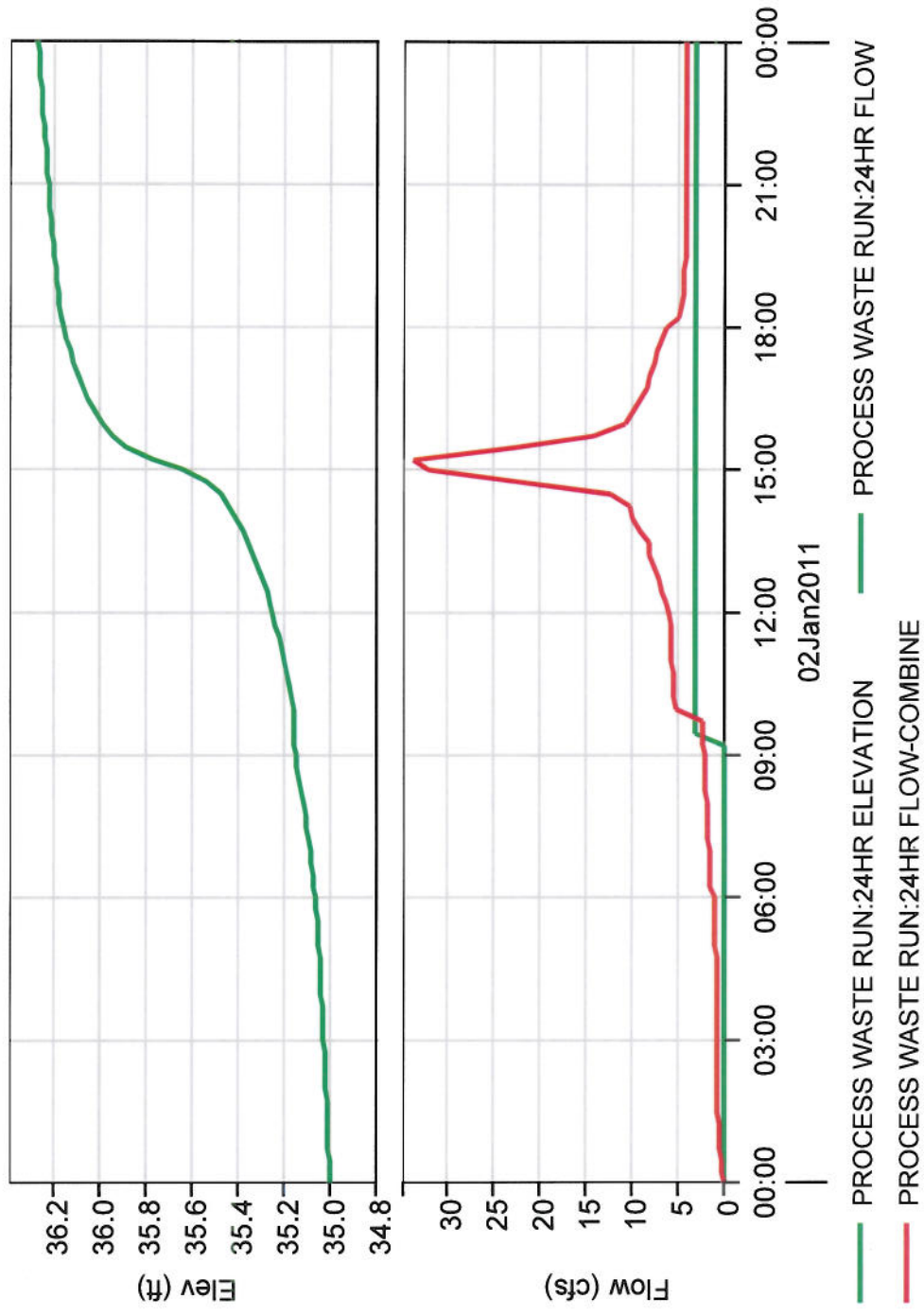
Scenario No.4
2/3 Ash Pond
24hr Event



Scenario No.4
Scrubber Waste Pond
24hr Event



Scenario No.4
Process Waste Pond
24hr Event

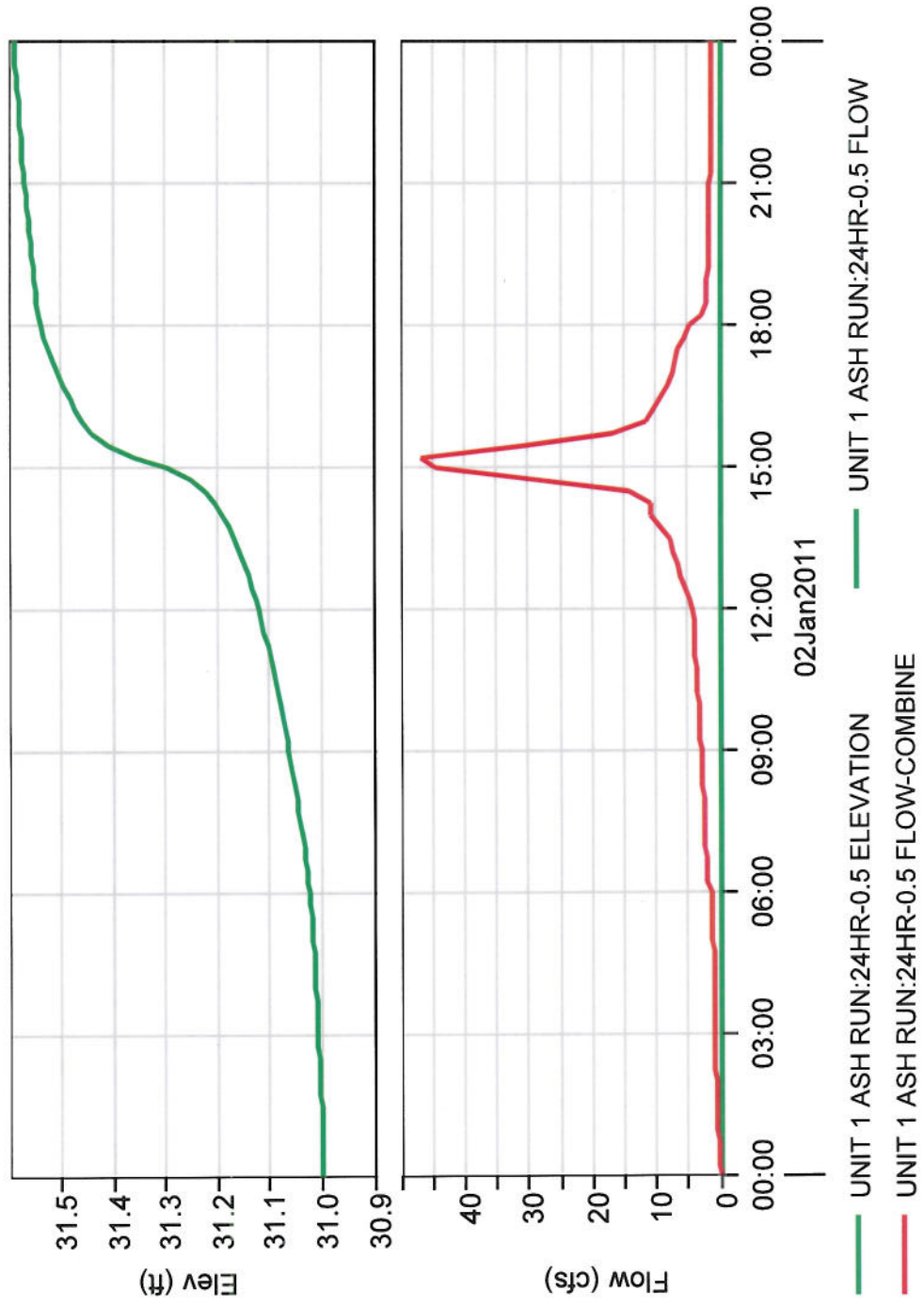


Scenario No. 4

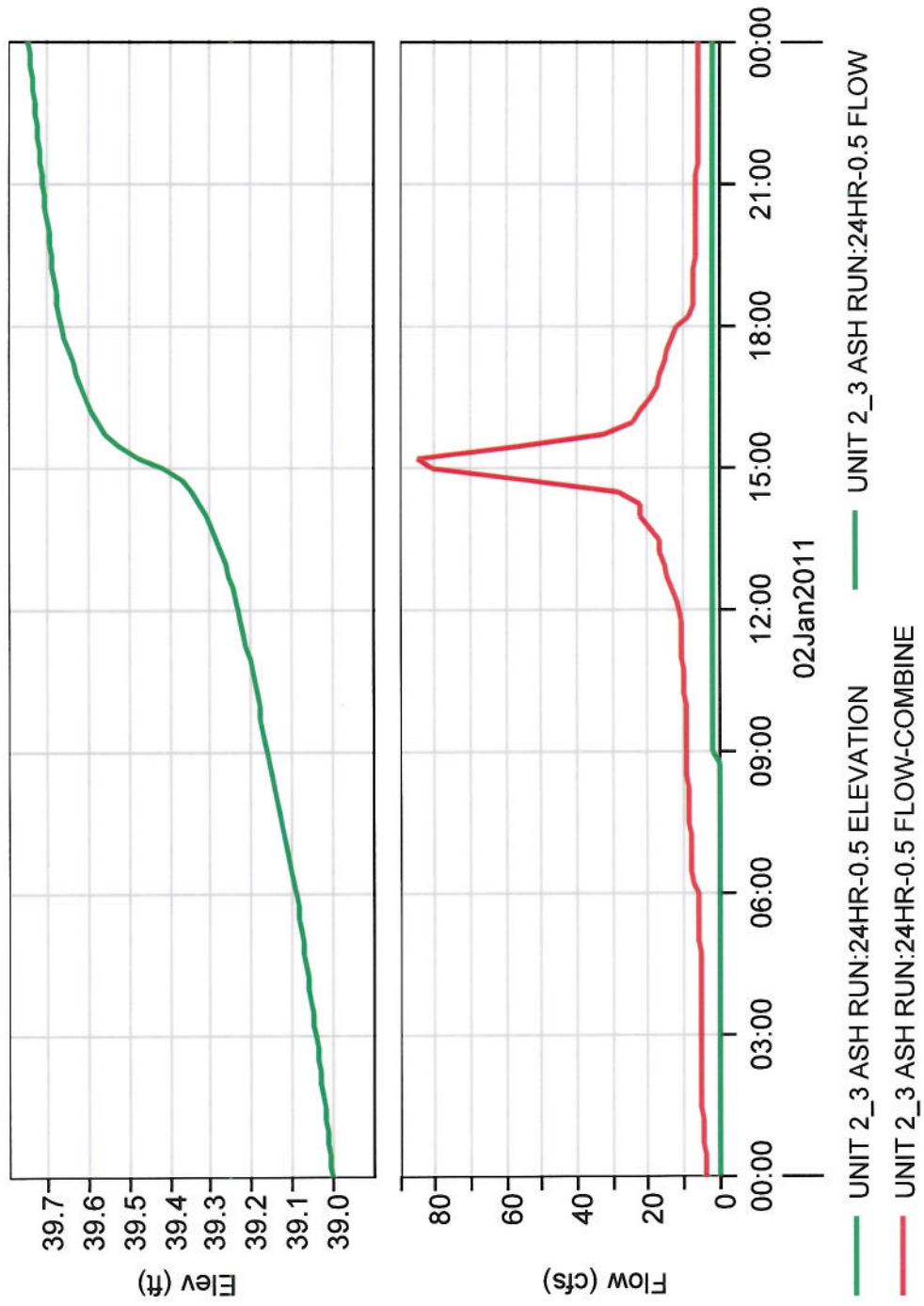
24hr Rain Event-50% PMP

HEC-HMS Scenario Results

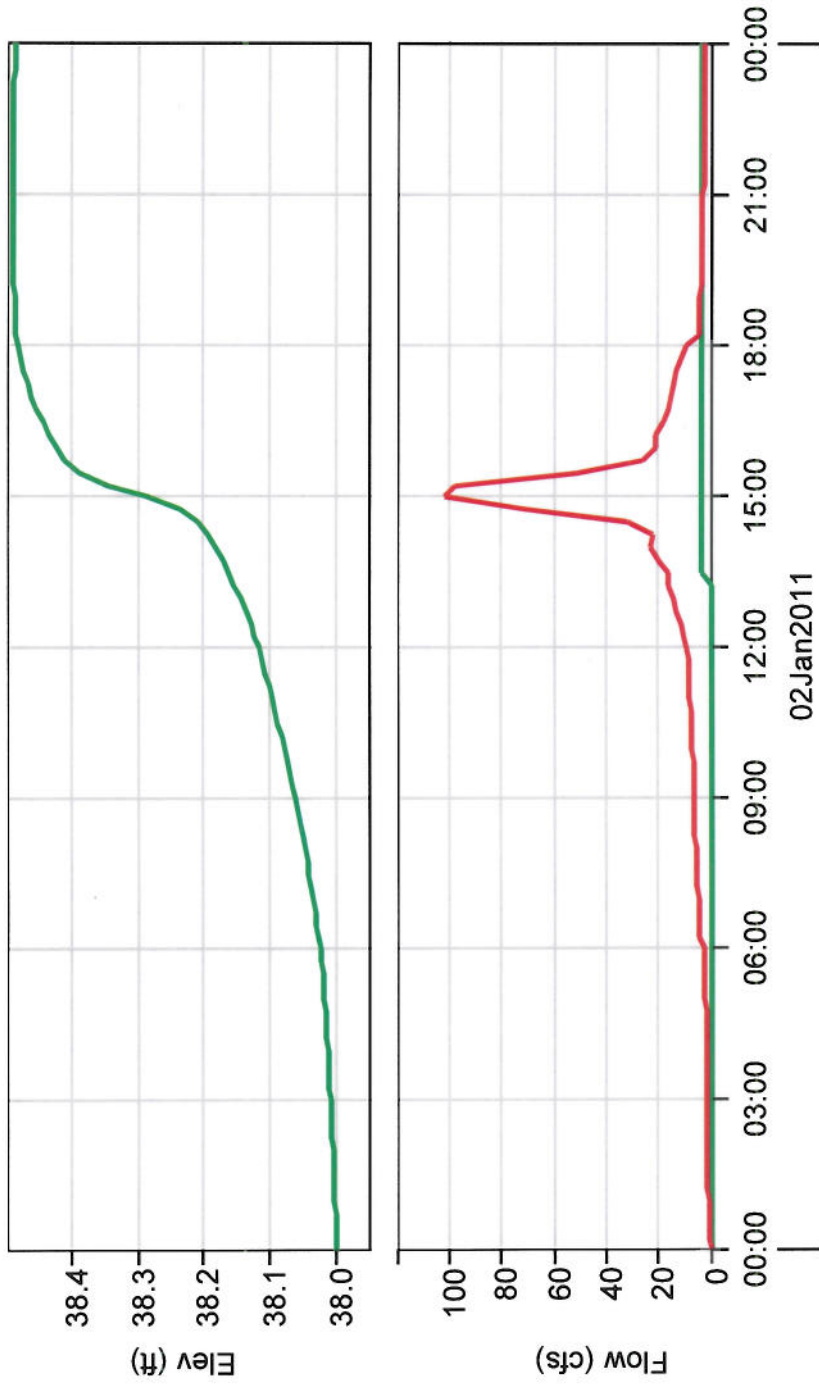
Scenario No.4
Unit 1 Ash Pond
24hr Event-50% PMP



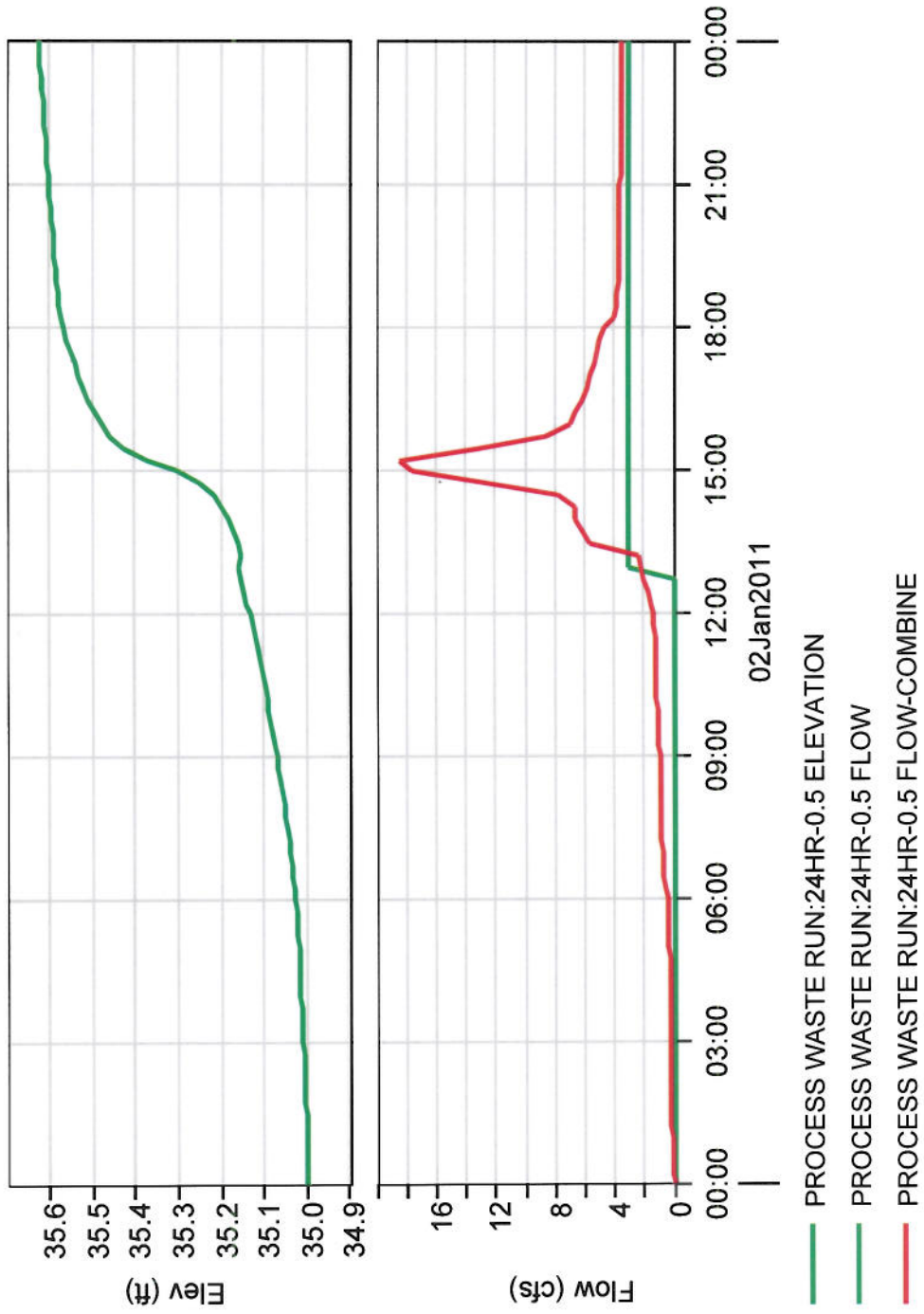
Scenario No.4
Unit 2/3 Ash Pond
24hr Event-50% PMP



Scenario No.4
Scrubber Waste Pond
24hr Event-50% PMP



Scenario No.4
Process Waste Pond
24hr Event-50% PMP



Scenario No. 4

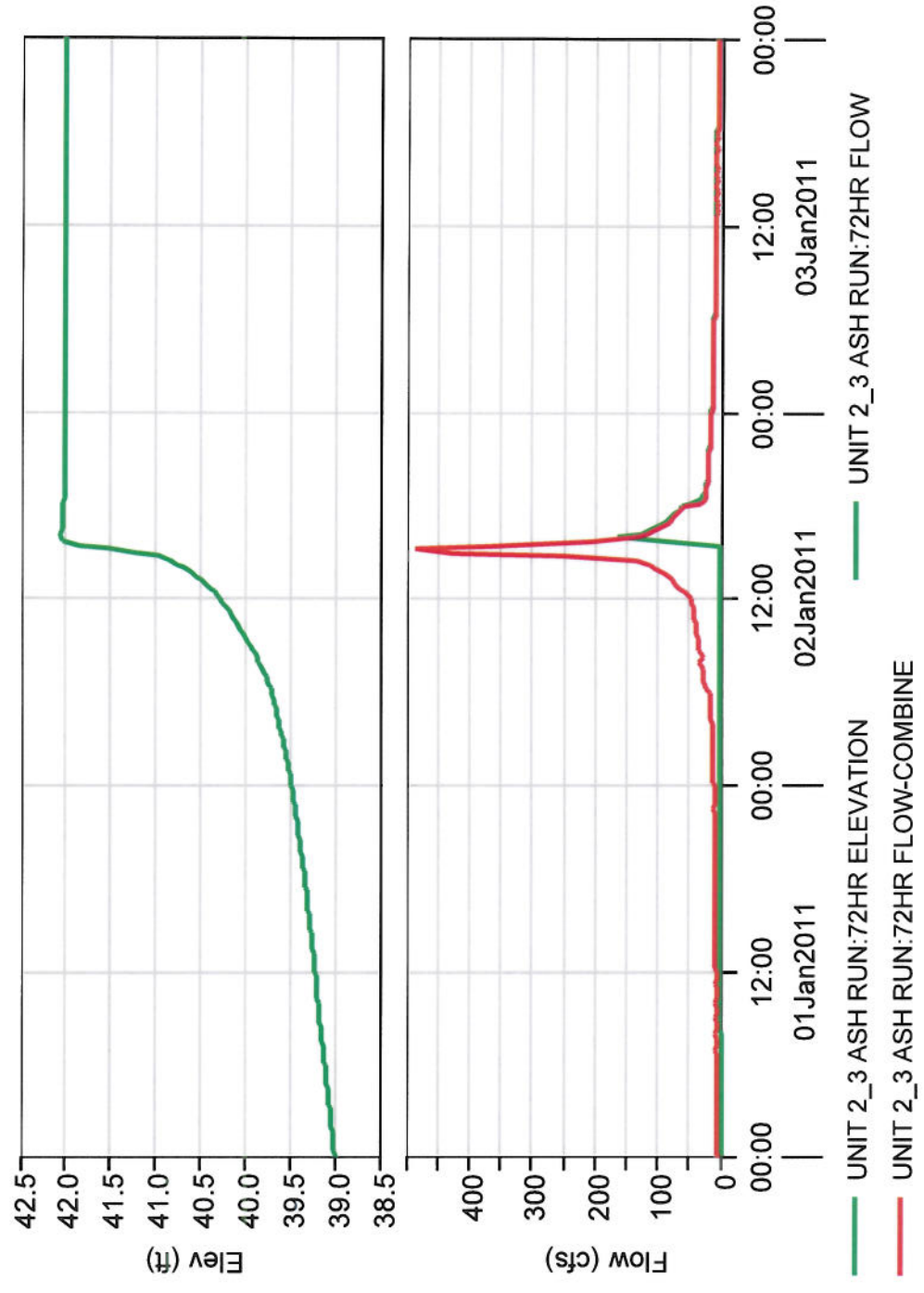
72hr Rain Event

HEC-HMS Scenario Results

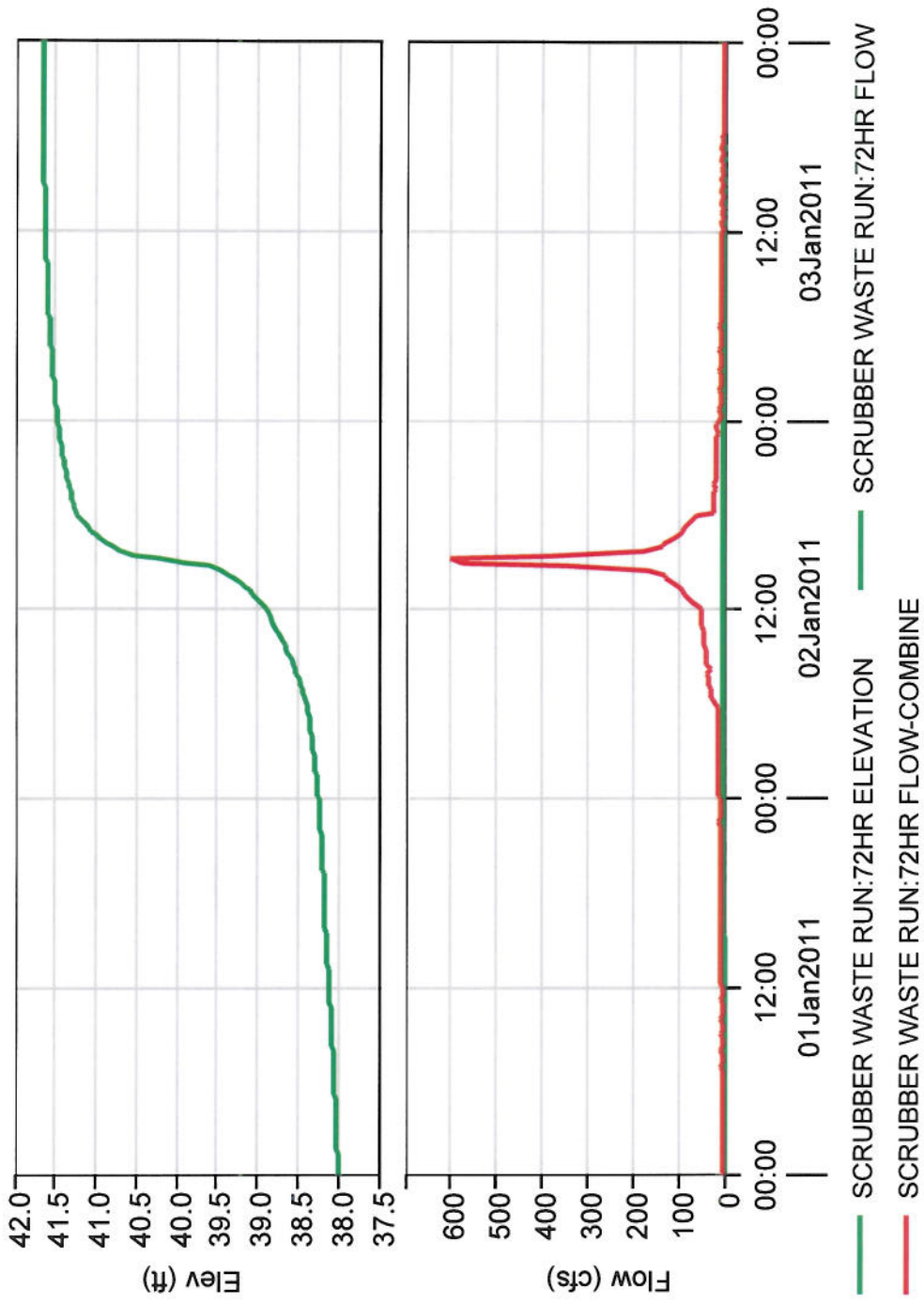
Scenario No.4
Unit 1 Ash Pond
72hr Event



Scenario No.4
2/3 Ash Pond
72hr Event



Scenario No.4
Scrubber Waste Pond
72hr Event



Scenario No.4
Process Waste Pond
72hr Event

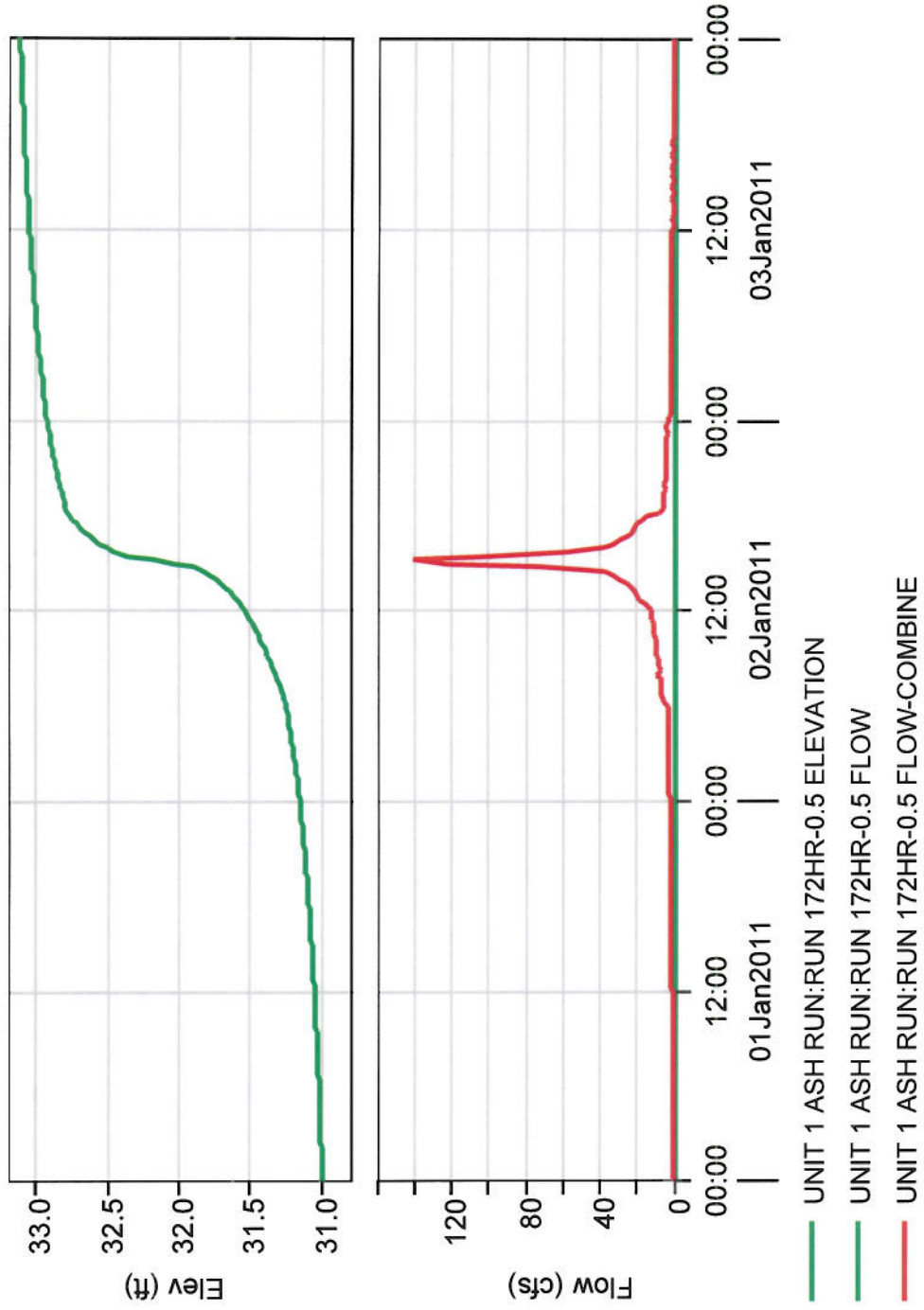


Scenario No. 4

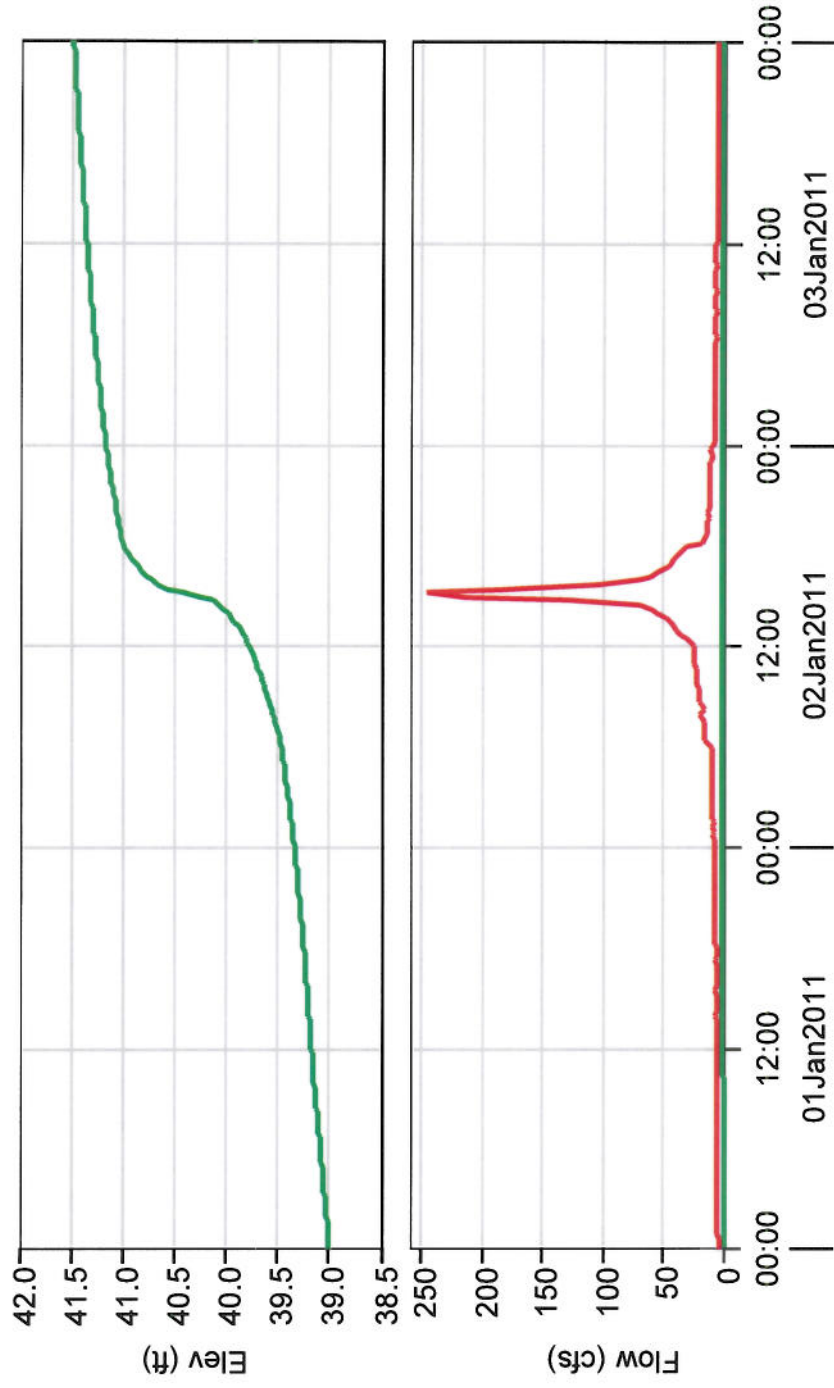
72hr Rain Event-50% PMP

HEC-HMS Scenario Results

Scenario No.4
Unit 1 Ash Pond
72hr Event-50% PMP

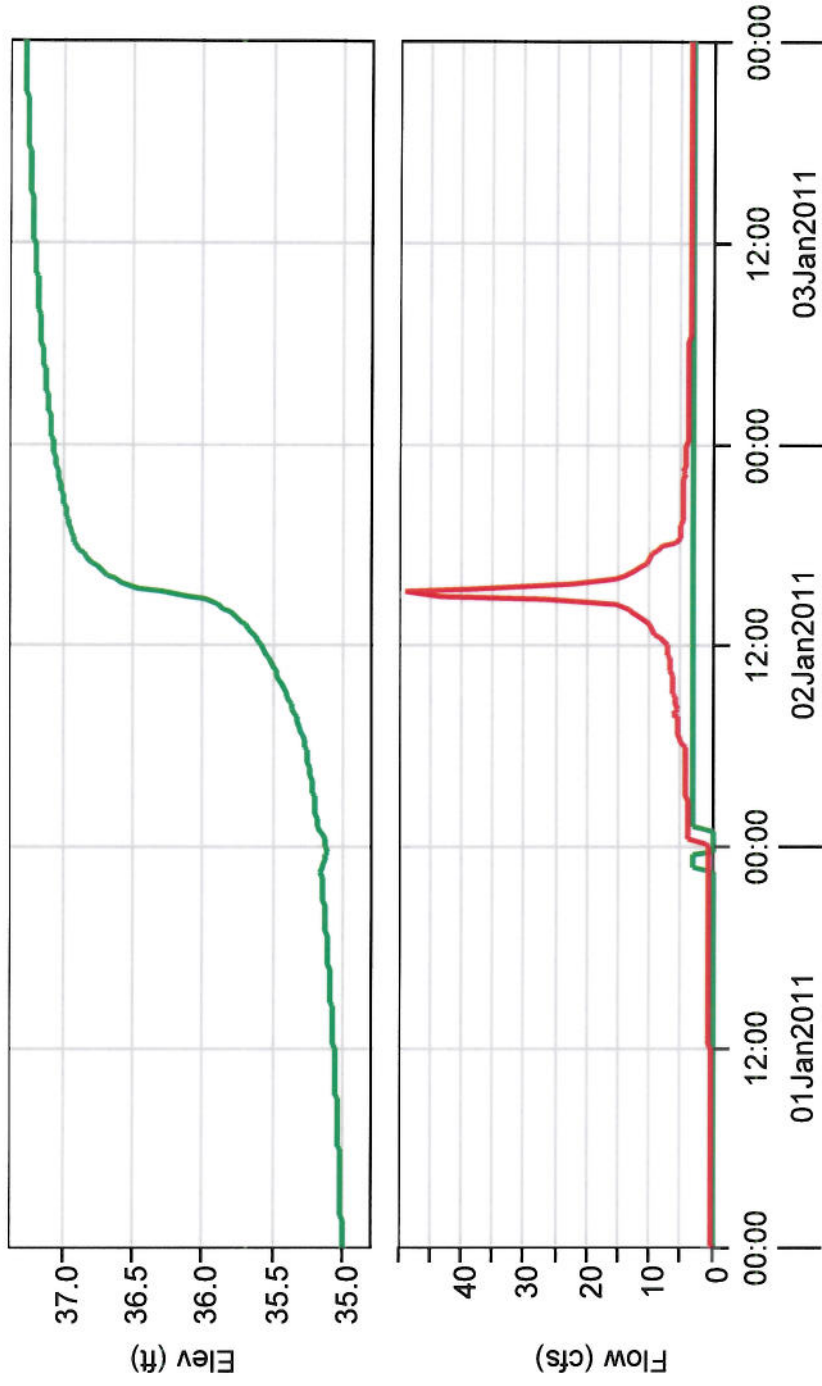


Scenario No.4
Unit 2/3 Ash Pond
72hr Event-50% PMP

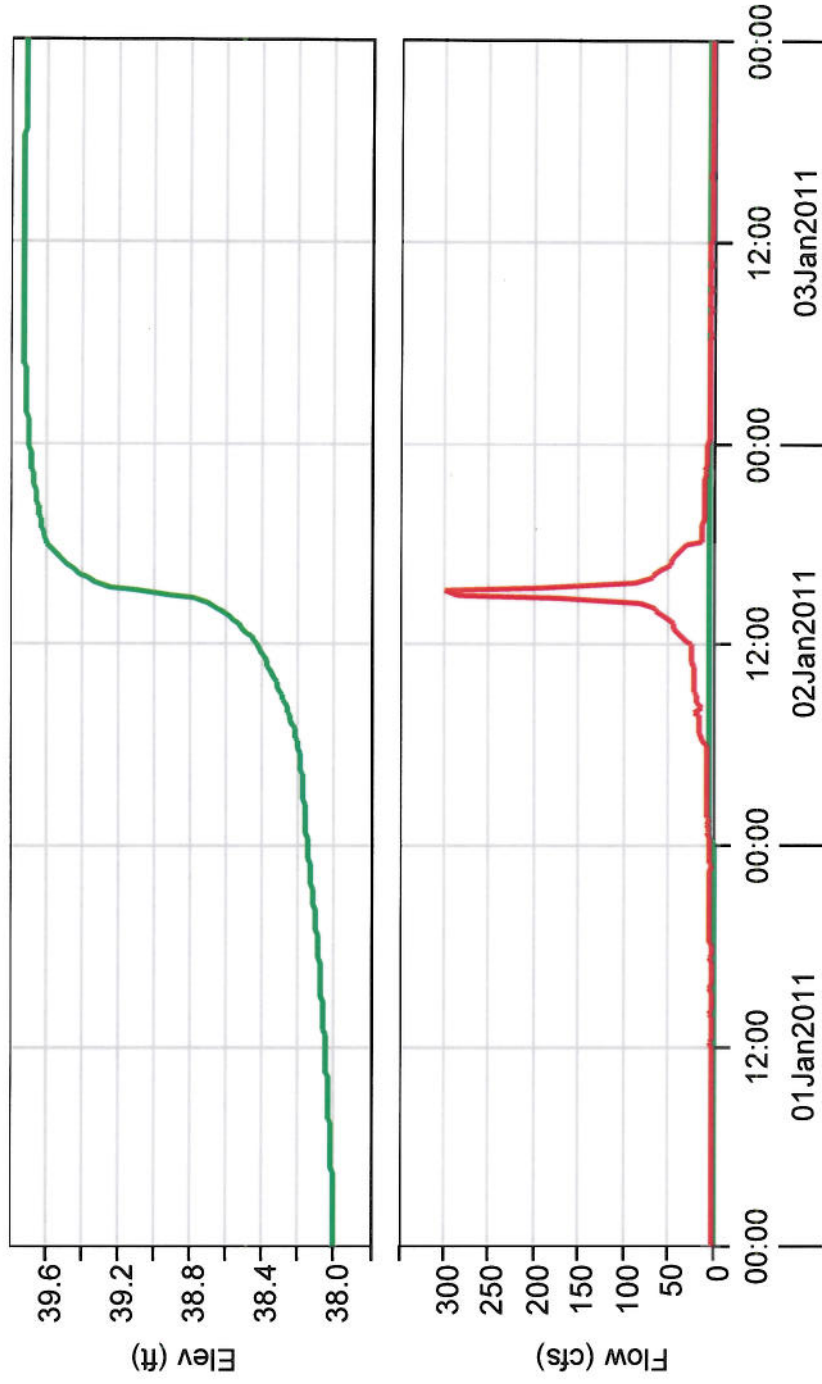


- UNIT 2_3 ASH RUN:RUN 172HR-0.5 ELEVATION
- UNIT 2_3 ASH RUN:RUN 172HR-0.5 FLOW
- UNIT 2_3 ASH RUN:RUN 172HR-0.5 FLOW-COMBINE

Scenario No.4
Process Waste Pond
72hr Event-50% PMP



Scenario No.4
Scrubber Waste Pond
72hr Event-50% PMP



- SCRUBBER WASTE RUN:RUN 172HR-0.5 ELEVATION
- SCRUBBER WASTE RUN:RUN 172HR-0.5 FLOW
- SCRUBBER WASTE RUN:RUN 172HR-0.5 FLOW-COMBINE